BULLETIN

OF THE

Scientific Laboratories

OF

DENISON UNIVERSITY

VOLUME X.

MEMORIAL VOLUME.

ILLUSTRATED.

EDITED BY
W. G. TIGHT, M.S.,
Department of Geology and Natural History.

GRANVILLE, OHIO.

BARNEY MEMORIAL HALL SOUTH FRONT

BULLETIN

OF THE

Scientific Laboratories

OF

DENISON UNIVERSITY.

VOLUME X.

MEMORIAL VOLUME.

ILLUSTRATED

EDITED BY

W. G. TIGHT, M.S.,

Department of Geology and Natural History.

GRANVILLE, OHIO, AUGUST, 1897.

The University Press.
GRANVILLE, OHIO.

CONTENTS,

LIST OF ILLUSTRATIONS.

BARNEY MEMORIAL SCIENCE HALL—NORTH EAST ENTRANCE

EDITORIAL STATEMENT.

When the Barney Memorial Science Hall was completed and the work fairly begun in the new quarters the advantages presented to the student were so great, as compared to those which the writer had enjoyed in the early days under Professor Hicks, that the fact of the great debt we owe to the laborers of the past and the foundation that they laid was so forcibly presented as to suggest the thought of collecting in some permanent form such facts as could be obtained with reference to the work in science in Denison University and the lives and works of those who wrought so faithfully in the past. In order to show the fruits of their labors it is also important to show the present state of the scientific work and equipment.

In tracing the development of science in this country, and especially the development of the scientific laboratories, the very significant fact is manifest that almost all the large laboratories have been built and equipped through the generosity of broad minded and public spirited men of large fortune.

It is true that the United States government and most of the States have, at public expense, made large investments in the building of experiment stations and research laboratories for scientific work and instruction. Yet it cannot be said that in this country the government is the leading patron of the scientific laboratory. In many other countries the government has taken the leading part in furnishing the means for the pioneer work in the development of the scientific laboratories; but with our form of government, where the mass of the people is the governing power, it is evident that the people must first be shown the benefits to be derived from the establishment of such expensive plants for scientific work before they will vote their money to the support of such enterprises.

Thus it is that while the value of public schools maintained at public expense was early recognized as a necessity and provided for, yet it must be said that the higher institutions of learning have largely

been founded and fostered by private means. This is not more marked in any department than that of science.

The founding and maintainance of scientific laboratories and experiment stations as government institutions, at large expense, marks a later stage in the development of scientific work; when the majority of the people have been so educated that they recognize the benefits, to the commonwealth, to be derived from the encouragement of research laboratories then they are willing to vote a tax on themselves for their construction and support.

The development of these public laboratories under governmental patronage has in no way checked the investment of private wealth for the still larger growth of science and scientific instruction. It will probably always be true that the advance steps will be taken in the future as in the past through the patronage of liberal minded men and women of large fortune.

In the growth of the scientific laboratories of this country there are then two factors present -the scientific student, worker, investigator or teacher and the patron of science. While we are remembering the one we can not forget the other.

It is the plan therefore to include in this volume an outline of the development of the scientific work in Denison University, a brief sketch of the lives of those who have been connected with the work, the patron who has so generously placed science here on its present basis, the present condition of scientific instruction and the present instructors, with a short description of the scientific equipment as found in Barney Memorial Science Hall.

The papers thus far published in the Bulletins are largely of a technical character and our excuse (if such is necessary) for introducing this volume in the series is found in the words of Professor C. L. Herrick, the founder of the Bulletin, in his editorial statement to the first volume, where he says, "The Bulletin is intended to represent the life of the college in its scientific departments and may incidentally serve to illustrate to distant friends the facilities for work afforded, as well as needs unsupplied." It is hoped that the matter contained herein will be of interest to our distant friends and that perhaps others may get some new ideas from our equipment as described and illustrated, as we received many from similar volumes furnished us by our distant co-workers.

In the preparation of this volume our obligation is expressed to President D. B. Purinton; Professor W. H. Johnson, of the department of Latin; Professor A. D. Cole, of the department of Physics and Chemistry; Professor C. Judson Herrick, of the department of Biology; and Mr. B. F. McCann, of Dayton, O., for various portions of the historical, biographical, and descriptive text. Credit is given in the text for articles quoted. Also to Professor W. H. Boughton, of the department of Mathematics and Engineering, for the drawings of the floor plans of Memorial Hall; to Mr. L. I. Thayer, a student in photography in the department, for most of the photographs of the interiors of Memorial Hall; to Mrs. Burton Huson for the loan of Professor L. E. Hick's picture from which the cut was made, and to the Board of Trustees for the special appropriation for the expense of publication.

The cuts for the illustrations were all made by the Editor, in the department of Photography and Engraving, and should they not come up to the standard of such work it is hoped the deficiency will be pardoned from the fact that they are the work of an amateur and furnished the Editor's recreation during their preparation.

DENISON UNIVERSITY CAMPUS FROM THE EAST

HISTORICAL SKETCH.

Denison University was founded before the era of the Natural Sciences as an important part of college education began, and therefore not much can be said of scientific studies at Denison in its earlier history. The primary object in the minds of its founders had been to make provision for educating Ministers of the Gospel, in order to facilitate the evangelization of Ohio's rapidly increasing population. It was recognized, however, that the young minister needed something more than a purely theological training; and what the predominating character of that additional study was to be was indicated in the name chosen for the school, —*The Granville Literary and Theological Institution*.

For more than twenty years from the beginning the Faculty rolls show no closer approach to a recognition of the Natural Sciences than the title Professor of Mathematics and *Natural Philosophy*. An examination of the catalogues, however, shows that one term's work was generally given to Chemistry and one to Geology and Mineralogy. It is evident that these branches were taught as extras by the Professors in other departments, and under such circumstances the instruction must have been confined largely to text-book work.

In 1853, a Professorship of Natural Sciences was instituted, but disappeared after a single year, the incumbent, Professor Fletcher O. Marsh, being transferred to the chair of Mathematics and Natural Philosophy. During this year, however, Botany, Anatomy and Physiology were added to the curriculum, and a separate Scientific Course was published, with the promise that the degree of Bachelor of Science would be conferred upon those by whom it should be taken. It was stated that this course was "designed to furnish a suitable education to those who are fitting themselves for business men, for engineers, or to engage in mercantile or mechanical pursuits." This course was one year shorter than the Classical, and contained no work in any language other than English.

In the catalogue of 1854 appears the first announcement of an Agricultural Department, which deserves mention here as indicating good intentions in the direction of scientific work, although such intentions were never carried into effect. The announcement was as follows: "The Trustees have resolved to establish an Agricultural Department, in which the best facilities for obtaining a knowledge of the science of agriculture shall be afforded, consisting of lectures, experiments and general instruction in those sciences which have a more direct relation to this important branch of industry; embracing a period of fifteen weeks, during the second term of each year. Instruction in this department will * * * afford the sons of farmers, and others, an opportunity to spend the winter months in listening to lectures from scientific professors and practical agriculturists, who will be employed to give instruction in Agricultural Chemistry, embracing the nature of the soil in this state, and its adaptation to the different productions of this latitude, and the best means by which the different kinds of soil may be enriched; in Practical Mechanics, embracing the structure of buildings, fences and farming tools, with referenence to durability, utility and economy; In Geology, embracing the mineral resources of the State; in Agricultural Jurisprudence, embracing the laws relating to deeds of conveyance, trade and agricultural pursuits; in Animal and Vegetable Physiology, embracing the kind of animals adapted to the climate, the best methods of rearing them, the diseases to which they are subject, their comparative expense and the means of their improvement, and the culture of the different kinds of grain and fruit."

From the period just considered to the year 1870 no new scientific studies were added to the curriculum, and during a portion of the time Botany disappeared. In the enlargement of the Faculty which followed the completion of a new endowment fund, in 1867, no Professor or Instructor in science was added, the small amount of scientific work provided for in the curriculum still remaining in the hands of the occupants of other chairs. In the catalogue of 1870, however, appears the name of Lewis E. Hicks as Professor of the Natural Sciences and it is only from this date that Denison can fairly be said to have comprised a Scientific Department of study. This addition affected immediately the Classical as well as the Scientific Course. Besides the Chemistry, Geology and Mineralogy, and Anatomy, Physiology and Hygiene of former years, Classical students were now required to take "Natural History" and Vegetable Physiology in

the Sophomore year, and Zoology in the Junior. Vegetable Physiology and Zoology are the only additions which immediately appeared in the Scientific course, though the results accomplished in the branches before taught were doubtless more satisfactory now that these branches were in the hands of one who could give his time almost entirely to scientific work. We say *almost*, since Professor Hicks was compelled by the exigencies of the situation to do some work in unrelated lines of study, just as others had been compelled, previous to his appointment, to do scientific work. German and French were first added to the Scientific Course during this year. It was not until 1881, however, that the course was lengthened from the three year limit and made equal to the Classical Course in the number of years of collegiate study required. This equality of time, however, was more apparent than real until 1886, since the requirements for entrance to the Freshman class were less exacting by one year's work than for Classical students until that date. This shortness of the Scientific Course did an injury to the development of scientific work at Denison even greater than the deficiency of time, in that it furnished a refuge for students who fell behind in their Classical work. As long as this condition continued the presence of a small element of such men in the Scientific Department undoubtedly tended to deter bright students from becoming candidates for the Bachelor of Science degree. Of course there were those whose preference for Scientific work was sufficently strong to cause them to disregard this feeling, but the experience of the last ten years has shown beyond a doubt that the course has become much more popular by being made longer and harder. It is a significant fact that the phrase "*gone Scientific*," is no longer understood in student parlance as an equivalent for "failed in Greek and Latin."

It is due to Professor Hicks, of course, to say that this condition of affairs was decidedly contrary to his own desires in the matter. He would gladly have lengthened and strenthened the work in Science if the income of the University had been sufficient to provide the necessary additional teaching force and equipment. A great deal of illustrative material was accumulated by his personal efforts, and by others under his direction, which could not be used to advantage during his term of service because of the narrow quarters in which the work of the department had to be carried on. Under present conditions this material is now largely available for the practical purposes of instruction, and thus an important portion of his labor for the University is now bearing its first fruits.

PROFESSOR LEWIS EZRA HICKS, A.M.

Professor Hicks was born at Kalida, Putnam County, Ohio, March 10, 1839. He had not yet completed his college education when the War of the Rebellion began, but he fought in the Union army during the whole four years, serving as Lieutenant Colonel in the 69th O. V. I. After the close of the war, he completed his college course at Denison, doing some teaching as an Assistant in the Preparatory Department at the same time and graduating with the A. B. degree in the class of 1868. During the following year he remained as a Tutor in the Classics. He then went to Harvard for a year to pursue special work in Zoology and Geology, where he had the good fortune to be a student under Louis Agassiz.

In 1870, he came back to Denison as Professor of Natural Sciences, and remained until 1884, when he resigned to accept the chair of Geology in the University of Nebraska. During the last two years of his service at Denison, the title of his Professorship was changed to Geology and Natural History, in view of the endowment of a chair of Chemistry and Physics, by the Chisholms, of Cleveland. Professor Hicks retained his chair in the University of Nebraska until 1891, and during a portion of this time was also connected with the United States Department of Agriculture, as Assistant Geologist. He was a member and fellow of the American Association for the Advancement of Science; a member of the American Society of Irrigation Engineers; one of the founders of the Geological Society of America, and a Fellow of the same, as well as one of the founders of the *American Geologist* and long an Associate Editor. From the 1893 edition of the General Catalogue of Denison University we take the following list of his contributions to scientific literature, a list not intended to be exhaustive: "Scientists and Theologians: How they Disagree, and Why," a series of articles in the Baptist Quarterly Review, 1874; "A Critique of Design Arguments," an octavo volume of 417 pages published by the Scribners in 1883; "Discovery of the Cleveland Shale in Central

Professor Lewis Ezra Hicks, A. M.

Ohio," American Journal of Science, 3d Series, Vol. 16, p. 70; "The Waverly Group in Central Ohio," ib., p. 216; "The Dakota Group in Nebraska," Proceedings of the American Association for the Advancement of Science, Vol. 34; "Irrigation in Nebraska," Bulletin No. 1, of the Agricultural Experiment Station of Nebraska; an article on the same subject in the Report of the Nebraska State Board of Agriculture, 1887, p. 122; "The Soils of Nebraska," (with a geological map of the state), Report of the State Horticultural Society of Nebraska, 1888; "The Permian in Nebraska," Proceedings of the American Association, Vol. 36, p 216; an article on the same subject in the American Naturalist, Vol. 20, p. 881; "Geology in its Relations to Agriculture," Report of the State Board of Agriculture, 1889, p. 364; "Silting, or Basin Irrigation," ib., 1890, p. 131; "Storage of Storm Waters on the Great Plains," ib., 1891, p. 172; "An Old Lake Bottom," Bulletin of the Geological Society of America; "Artesian Wells in Nebraska," Senate Executive Document, 222, 51st Congress (with geological map of Nebraska); "Soils and Waters of the Lake Region, as Related to its Geological Structure," Report of the Nebraska Board of Agriculture, 1892; "Irrigation and Horticulture," Report of the State Horticultural Society, 1892, p. 78; "Tree planting in Canons," ib, 1893; "Evolution of the Loup Rivers," Science, Vol. 19, No. 469, Jan. 29 1892; "Some Elements of Land Sculpture" Bulletin of the Geological Society of America, Vol. 4, p 133; "Irrigation in Nebraska," Senate Executive Document, 41, Part III, 52nd Congress, First Session.

In addition to his scientific work, Professor Hicks maintained always a lively sense of his responsibilities as a member of society and as a citizen. He took a deep interest in all political questions and was entirely independent of party dictation at a time when independence was not yet common, a fact which made it inevitable that his political position should sometimes be misunderstood. In Lincoln, Nebraska, his activity in municipal politics resulted in his elevation to the Chairmanship of the Board of Public Works. He is now engaged in college work in Burmah.

PROFESSOR ISAAC JUSTUS OSBUN, A.B.

The work of the above mentioned Chair of Chemistry and Physics (founded in memory of Henry Chisholm, of Cleveland, by his children) was divided up and assigned to other Professors for a year and then placed in charge of Isaac J. Osbun, as Professor of Chemistry and Physics.

Professor Osbun was born in Windsor, Ohio, May 19, 1850. He was for six years a student in Granville, entering in the Preparatory Department in 1866 and graduating in the Classical Course, with the class of 1872. After a year's work as Principal of the Glendale High School he went to Europe and spent two years as a student in the Universities of Stuttgart, Tuebingen, Heidelberg and Paris. Upon his return he was chosen Principal of the Berkshire Institute, New Marlborough, Massachusetts, but gave up this position a year later to accept the Professorship of Chemistry and Physics in the State Normal School at Salem, Massachusetts, where he remained for seven years, resigning to take his Professorship at Denison, in 1883. Here he died, December 8, 1884, in the first term of the second year of his work. We include here a number of extracts from an article written for the Denison Collegian soon after his death by Dr. W. C. Davies, between whom and Professor Osbun there had existed a very intimate friendship from his student days until the end of his life:

"During his college course, he displayed great love for the sciences. Not content to blindly accept the statement of the text-book or teacher, he wanted to work out principles for himself. Lack of apparatus he did not allow to become a hindrance, but transformed his room into a workshop. The writer of this article well remembers many a piece of home made apparatus which he borrowed to demonstrate the principles of Physics to his own pupils. [Dr. Davies was then in charge of the Granville schools.] Though home-made, they always answered the purpose for which they were made, and gave evidence of the originality and skill which, in later years, found a wider

Professor Isaac Justus Osbun, A. B.

field of operation. The child is father to the man, and these traits which marked his life as a student became important characteristics of his work in teaching. The enforced dependence upon himself for means to demonstrate what he would not accept without demonstration, was valuable training for his future work." [The compiler of this article well remembers, as a student under Professor Osbun, the habit of insisting upon actual demonstration to which Dr. Davies here calls attention. It often seemed irksome to be required to perform a series of experiments in the laboratory in order to demonstrate to the eye some principle which presented no difficulty whatever to the mind, and had perhaps been understood and accepted as almost self-evident long before; but it is easy to see now that this was done not primarily for the sake of the particular point involved in the experiment but to establ sh the experimental habit more firmly in the character of his pupils.]

"During his college course, Mr. Osbun was a faithful student, leading his class in all studies that were congenial to him. He was an earnest and active member of his literary society, especially liking, and excelling in, debate * * * Of Professor Osbun's life and work since he returned to us, a little more than a year ago, much *might* but little *need* be said. They speak for themselves. Not only do his associate teachers and the students mourn his loss, but his death touched a chord which vibrated through the whole community. Measured by years, his life was short. At thirty-four, we look upon a man's life as only fairly begun. Measured by what he accomplished, a man of three score would have no cause to blush. His life was one of unceasing activity. To be idle was to him simply impossible. During the vacation following his Junior year, in a country school house a few miles from Granville, he delivered his first scientific lecture, illustrated by experiments of his own devising. It was the first of a long list. When teaching at Salem he delivered as many as sixty lectures in one year. These lectures embraced a great variety of subjects, and, while some were delivered before popular audiences, many were before the most cultivated and critical scientific associations. He delighted to choose some simple subject and lecture on it before those destitute of scientific training; and the ability he displayed of clothing the bare facts of science with so much interest that he fascinated as well as instructed even the most ignorant of his hearers, was signal proof of the originality of his mind and thoroughness of his preparation. Even va-

cation was not a time of rest to him. One summer he spent in aiding Professor Bell to perfect the telephone. During another, that of 1882, he lectured at Martha's Vineyard, before the Summer School of Sciences. In fact he was in almost constant demand at Teachers' Institutes and Associations. He wrote many articles on scientific subjects, for publication. * * *

"His heart was in his work to the very close of life. The dying warrior on St. Helena in his delirium imagined himself at the head of his army, and our teacher carried on his work to the last. The first indication that his mind was "wandering" came at midnight, in a direction, clear and sharp, to his class, in regard to the performance of an experiment. His mind, released from the control of the will, was true to itself and its chosen work to the very end. As a teacher he attained the very highest success, and this success which crowns his life was the legitimate reward of straightforward, earnest, well directed and persevering toil. He magnified his work, and the results of his work, written in the minds and hearts of those whom he taught, constitute a monument to him more enduring than granite."

Epoch making work is not always at once realized as such, but it was easily seen at the time that Professor Osbun's year at Granville had inaugurated a new epoch in the scientific work of Denison University. An editorial in the Collegian said:

"Professor Osbun, feeling that his work could not be a success without certain fundamental improvements, made his coming conditional upon their supply. He has been on the field a little more than a year, and a revolution has already been wrought whose effects will be seen in all coming years. Never again, under any circumstances, can the work of this department be what it was before. All his training and experience had taught him what must be done that the work might be worthy of the college and himself, and with the persistency which was his characteristic, he toiled to gather and utilize everything that could be reached."

The curriculum as it stood during the year of Professor Osbun's death contained the following scientific work: candidates for the degree of Bachelor of Science were required to take Chemistry during the whole of the Freshman year and one term of the Junior year. Physiology was required during the Winter term of the Sophomore year, and Botany, with some other scientific study to be chosen, during the Spring. The work in Botany was continued during eight weeks of the

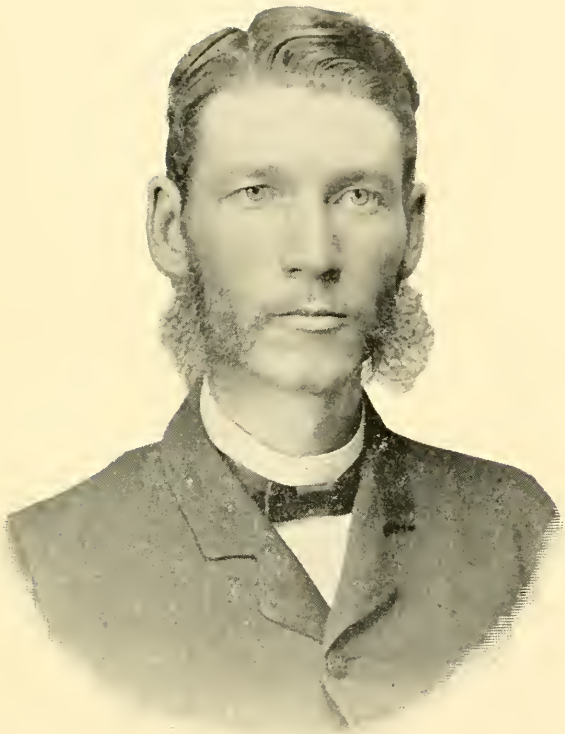
Fall term of the Junior year and this was followed by Zoology during the remainder of the term. In the Senior year, Geology was taken during the Fall term and Paleontology during the Winter. About half as much scientific work was required of students in the Classical and Philosophical Courses. With the addition of new studies and appliances, the amount of floor space devoted to the work had been increased more than threefold by the sacrifice of dormitory rooms on the first and second floor of the "New Brick," and thus the work of instruction was made much more effective than it had been in former years A temporary water supply for the work of the laboratories had been secured by drilling a well on top of College Hill and putting in a wind pump, but this never furnished a satisfactory supply and was soon superseded by the Granville water works, constructed during the year 1885-6. For the remainder of the year of Professor Osbun's death, the work of the department of Chemistry and Physics was done by Nathan F. Merril, Ph D. At the opening of the following year, Professor A. D. Cole, a graduate of Brown, who had been doing Post-Graduate work at Johns Hopkins, took charge of the department and still remains, having been absent one year pursuing special researches in Physics at the University of Berlin. During his absence, the work of the chair was in the hands of Mr. E. P. Childs, a graduate of Denison, and now Professor of Science in the High School of Pueblo, Colorado. The development of the Department under Professor Cole made necessary in 1896 the employment of an Assistant, Mr. H. C. McNeil, who graduated from Denison in the Scientific Course with the class of that year. Previous to the endowment of this Department, some work in Physics had been done by Professor Gilpatrick, in addition to his work in Mathematics, and still earlier by Professor Marsh. The work in Astronomy, done by the Professor of Mathematics, still connects this chair closely with the scientific portion of the Faculty; and the Assistant in Mathematics, Mr. W. H. Boughton, gives a portion of his time to instruction in Physics and Chemistry

PROFESSOR CLARENCE L. HERRICK, M.S.

To return to the chair of Geology and Natural History, after the resignation of Professor Hicks the University had the good fortune to secure the services of Professor Clarence L. Herrick, who had been employed for the work temporarily during a short visit of Professor Hicks to Europe for some special researches in the British Museum. Professor Herrick remained at Denison until 1889, then accepted the Professorship of Biology and Geology in the University of Cincinnati, which he held for three years, and then came back to Denison as Professor of Biology, remaining in active charge of the chair until 1894, when ill health compelled him to seek the climate of New Mexico. At the close of the last school year, very much to the regret of all concerned, he resigned his chair, in view of continued inability to endure the climate of Ohio with safety. Since that date, he has been chosen as President of the University of New Mexico and has entered upon his work.

Professor Herrick was born in Minneapolis, in 1858, and graduated from the University of Minnesota in 1880, where he remained as Instructor in Botany and Zoology during the following year. He spent the year 1881-2 in study in Europe, and then accepted the position of State Mammologist, in connection with the Geological Survey of Minnesota, in which work he remained until called to Denison.

Beginning upon the foundations which we have described, Professor Herrick gave an enormous impetus to all branches of scientific study. In spite of any adequate financial provision for such work, he began immediately the publication of the "Bulletin of the Laboratories of Denison University," which has now reached its tenth volume and has been of inestimable value to the University in stimulating original research, by furnishing an avenue for the publication of results, in calling the attention of scientists all over the educational world to the character of work done here, and in bringing to the Library by exchange a mass of scientific literature which could have been secured in no other



Professor Clarence L. Herrick, M. S.

way. While in the University of Cincinnati, he founded the *Journal of Comparative Neurology*, which was adopted as one of the official publications of Denison upon his return here in 1892, and has maintained a very high standing among neurologists ever since its appearance. It is now a joint publication of Denison and Columbia Universities, Dr. Strong of the latter being one of the editors. Its work, however, together with that of the Bulletin, is more fully described elsewhere in this volume.

Among Professor Herrick's literary and scientific contributions, exclusive of articles in the BULLETIN OF THE SCIENTIFIC LABORATORIES and the *Journal of Comparative Neurology*, the following partial list includes his principal writings:

Microscopic Entomostraca. *Geol. and Nat. Hist. Surv. Minn.* Seventh Ann. Rep., 1879.

Fresh-water Entomostraca. *American Naturalist*, 1879.

List of Birds of Minnesota.

List of Mammals from Big Stone Lake, with new sp., etc., *Annual Rep. Geological Survey of Minnesota.*

Types of Animal Life. A Laboratory Hand-Book. *Minneapolis, Minnesota*, 1881.

Habits of Fresh Water Crustacea. *American Naturalist*, 1882.

A New Genus and Species of the Crustacean Family of Lyncodaphnidæ. *American Naturalist*, 1882.

Papers on the Crustacea of the Fresh waters of Minnesota. I. Cyclopidæ of Minnesota. II. Notes on some Minnesota Cladocera. III. On Notadromas and Cambaras. *Tenth Ann. Rep. Geol. Surv., Minn.*, 1882.

Heterogenetic Development in Diaptomus. *American Naturalist*, 1883.

Hetrogenesis in the Copepod Crustacea. *Am. Naturalist*, Feb., 1883.

A new Genus and Species of the Crustacean Family Lyncodaphnidæ. *Am. Naturalist*, Feb., 1883.

A blind Copepod of the Family Harpacticidæ. *Am. Naturalist*, Feb., 1883.

A Final Report on the Crustacea of Minnesota included in the orders Cladocera and Copepoda. *Geol. and Nat. Hist. Surv. Minn.* 1884.

Outlines of Psychology: Dictations from Lectures by Hermann Lotze. Translated with the addition of a Chapter on the Anatomy of the Brain. *Minneapolis, Minn.*, 1885.

Contribution to the Fauna of the Gulf of Mexico and the South. *Mem. Denison Scientific Assoc.* Vol. I, No. 1. 1887.

Some American Norytes and Gabbros. *American Geologist*, Vol. I, No. 6, 1888. With E. S. CLARK and J. L. DEMING.

Science in Eutopia. *American Naturalist*, 1889.

Notes upon the Waverly Group in Ohio. *American Geologist*, Vol. III,

A Contribution to the Histology of the Cerebrum. *The Cincinnati Lancet-Clinic*, Sept. 28, 1889.

Modern Thought and Modern Faith *The Standard*, 1890.

Additions and Corrections to Miller's North American Palæontology. *American Geologist*, Vol. V, No. 4, 1890.

Notes upon the Brain of the Alligator. *The Journal of the Cincinnati Society of Natural History*, Vol. XII, 1890.

Suggestions upon the Significance of the Cells of the Cerebral Cortex. *The Microscope*, Vol. X, No. 2, 1890.

The Commissures and Histology of the Teleost Brain. *Anatomischer Anzeiger*, 1891.

Additional Notes on the Teleost Brain. *Anatomischer Anzeiger*, 1892.

Notes upon the Histology of the Central Nervous System of Vertebrates. *Festschrift zum siebenzigsten Geburtstage Rudolf Leuckart's*, 1892.

Mammals of Minnesota. *Bull. VII, Geol. Surv., Minnesota*, 1892.

Notes upon the Anatomy and Histology of the Prosencephalon of Teleosts. *American Naturalist*, Feb., 1892.

Wood's Reference Hand-Book of the Medical Sciences, Vol. IX, Suppl. 1893. Articles as follows :

1. The Comparative Anatomy of the Nervous System.
2. The Histogenesis of the Elements of the Nervous System.
3. The Physiological and Psychological Basis of the Emotions.
4. Waller's Law.

The Scope and Methods of Comparative Psychology. *Denison Quarterly*, Vol. I, Nos. 1-4, 1893.

Synopsis of the Entomostraca of Minnesota. *Second Report of the State Zoologist of Minnesota*, 1895. With C. H. Turner.

Microcrustacea from New Mexico. *Zoologisher Anzeiger*, No. 467, 1895.

The Testimony of Heart Disease to the Sensory Facies of the Emotions. *Psychological Review*, III, 3, 1896.

Suspension of the Spatial Consciousness. *Psychological Review*. III, 2, 1896.

The Critics of Ethical Monism. *The Denison Quarterly*, Vol. IV, No. 4, 1896.

The Psycho-sensory Climacteric. *Psychological Review*, III, 2, 1896.

The So-called Socorro Tripoli. *American Geologist*, 1896.

The Geology of a Typical Mining Camp. *American Geologist*, XIX, 4, 1897.

The Propagation of Memories. *Psychological Review*, IV, 3, 1897.

The Waverly Group of Ohio. *Final Report Geol. Surv. Ohio*. Vol. VIII.

The Waverly Group of Ohio, *Bulletin of the American Geological Association*.

Inquiries regarding Current Tendencies in Neurological Nomenclature. *Journal of Comparative Neurology*, Vol. VII, No. 3, 1897. With C. Judson Herrick.

Articles in *Baldwin's Dictionary of Philosophy and Psychology*, The Macmillan Co. [In Press.] With C. Judson Herrick.

The growth of the work in Professor Herrick's department, both in the College and Academy, made it necessary to secure assistance in 1888, and W. G. Tight, a graduate of Denison in the class of 1886, was employed as Instructor in the Academy. During Professor Herrick's connection with the University of Cincinnati and studies abroad, Professor Tight had charge of the collegiate work. Upon Professor Herrick's return to Denison the work of the department of Natural History was divided, Professor Herrick being Professor of Biology, and Professor Tight being Assistant Professor of Geology and Natural History. Later Professor Tight was given full charge of his department under the title of Professor of Geology and Botany. Since 1890, Professor Tight has been Editor of the BULLETIN OF THE SCIENTIFIC LABORATORIES, mentioned above as founded by Professor C. L. Herrick.

Upon Professor C. L. Herrick's resignation in 1897, the department was placed in charge of his brother, Professor C. Judson Herrick, who had performed a large part of the duties of the chair since January, 1894, with the exception of a year spent in special work at Columbia University, during which time the work was conducted by Mr. H. H. Bawden.

PRESENT CURRICULUM.

It is scarcely necessary to trace the growth of the curriculum step by step during the past ten years. It will serve all purposes to show its present condition, as found in the current catalogue of the University. Applicants for admission to the Freshman class in the A. B. course must have to their credit one term's work in Physical Geography, one in Physiology and one in Elementary Physics; for the Philosophical course, the same, plus an additional term in Physics and one in Botany; for the Scientific course, there is added still further one term's work in Chemistry, one in Anatomy and Physiology, and one in Mechanical Drawing. For the college work, we have thought it well to give the Classical and Scientific courses substantially complete, in order to show the amount of scientific work in each, in relation to other studies. Scientific studies appear in bold-baced type, in order to facilitate the work of comparison. No doubt the line between what is classed as Scientific and what is not will seem arbitrary in some cases, but that is hardly to be avoided.

For the Degree of Bachelor of Arts.

FRESHMAN CLASS.

FALL TERM.

**Latin.*—Cicero, De Senectute or De Amicitia, followed by Livy, Books I-II, or XXI-XXII; The Latin Subjunctive.

Greek.—Select Orations of Lysias; History of Athens under the Thirty Tyrants and Restoration of the Democracy.

Mathematics.—Part III of Olney's University Algebra.

Rhetoric.—Hart's, with Lectures, one hour a week.

* Separate entries in the courses are in many cases here abbreviated, but in no case omitted.

WINTER TERM.

Latin.—Livy or Sallust, followed by Cicero, De Officiis, or Select Letters.

Greek.—Herodotus and Thucydides.

Mathematics.—Part III of Olney's Geometry ; Plane Trigonometry.

American Literature.—One hour a week.

Rhetoric.—Hart's, with Lectures.

SPRING TERM.

Latin.—Horace, Odes and Epodes.

Greek.—Homer's Iliad; Peculiarities of the Epic Dialect.

Chemistry.—Experimental Lectures; Recitations; Laboratory Study of the Non-metals.

American Literature.—One hour a week.

Rhetoric.—Hart's, with Lectures.

SOPHOMORE CLASS.

FALL TERM.

Greek.—Demosthenes ; Greek New Testament, one hour a week.

Mathematics.—Olney's Trigonometry, Plane and Spherical ; General Geometry begun.

Rhetoric.

WINTER TERM.

Latin.—Tacitus, Germania and Agricola, or the Annals, or the Histories ; Letters of Pliny.

Mathematics.—General Geometry and Differential Calculus ; Lectures on the Integral Calculus, four hours a week.

Physiology.—Martin, four hours a week.

English Literature.—Lectures ; Select Reading, two hours a week.

Rhetoric.—Orations.

SPRING TERM.

Greek.—Apology and Crito of Plato ; Greek New Testament, one hour a week.

Botany.—Gray's Manual: Elements of Plant Physiology.

French.—Whitney's Brief Grammar ; Introductory Reader.

Rhetoric.—Essays and Orations.

JUNIOR CLASS.

FALL TERM.

Latin.—Rhetoric and Literary Criticism among the Romans ; The Dialogus of Tacitus, Book X of Quintilian and the "Literary Epistles" of Horace.

German.—Joynes-Meissner's German Grammar (Lessons I-XXXVI); Brandt's German Reader.

Rhetoric.—Essays.

ELECTIVES.

Mechanics.—Carhart's University Physics, Vol. I.

French.—Super's Historical Readings, last half of the term.

Spanish.—Manning's Spanish Grammar ; Knapp's Spanish Readings.

WINTER TERM.

A Science.*—(Zoology, Chemistry, or Physics.)

Logic.—Davis' Inductive and Deductive Logic ; Method ; Notes on the History of Logic ; Fallacies.

Rhetoric.—Essays, Studies in Shakespeare.

ELECTIVES.

Greek —Tragedies of Aeschylus and Sophocles.

German.—Joynes-Meissner's Grammar ; Schiller's *Wilhelm Tell ;* Müller's *Leitfaden zur Geschichte des deutschen Volkes ;* Harris' German Composition ; Dictation and Sight Reading.

Spanish.—Knapp's Readings ; Dictation and Sight Readings ; Selections from Galdos and Valera, Lope de Vega and Calderon ; Berlitz's Exercises.

Mathematics.

SPRING TERM.

A Science.—(Zoology, Cryptogamic Botany, Chemistry, or Physics.)

A Language.—Either

Latin.—The Roman Stage ; Plautus and Terence.

French.—Erckmann-Chatrian's *Le Conscrit de 1813* ; Halévy's *L'Abbé Constantin*, and Duval's *Histoire de la Littèrature*, or

German.—Müller's *Leitfaden zur Geschichte des deutchen Volkes ;* Riehl's *Burg Neideck ;* Harris' German Composition.

Rhetoric.—Orations.

ELECTIVES.

Astronomy.—Young's General Astronomy ; Lectures.

History.—Emerton's *Mediaeval Europe.*

English.—English Literature in the Nineteenth Century.

SENIOR CLASS.

FALL TERM.

Psychology.—Lectures.

History of Philosophy.—Weekly Lectures throughout the Fall and Winter Terms.

English Literature.—Lectures and Select Readings.

---

* The science elected this term for the first time must be continued through the Spring Term, except that Cryptogamic Botany may be substituted for the second term in Zoology.

ELECTIVES.

Geology.—LeConte; Laboratory and Field Work.

American Politics.—Johnston's *History of American Politics.*

French.

German.

Spanish.

WINTER TERM.

Ethics.—Lectures on Theoretical and Practical Ethics; Notes on the Philosophy of Ethics and the Moral Code.

Economics.

Rhetoric.—Orations.

ELECTIVES.

German.—Lessing's *Minna von Barnhelm;* Goethe's *Hermann und Dorothea;* Freytag's *Die Journalisten*; Collar-Eysenbach's German Lessons; Composition and Dictation; Themes on German History.

French.—Thier's *Bonaparte en Egypte;* Vacquerie's *Jean Baudry;* Masson's *Lyre Francaise;* Chassang's Grammar; Outlines of History, 1789-1848.

Italian.—Grandgent's Italian Grammar; Harper's *Principia Italiana*, Part II, or Bowen's or Montague's Reader.

Physiological Psychology.

SPRING TERM.

Evidences of Christianity.—Purinton's Theism.

ELECTIVES.

History of Civilization.—Guizot.

International Law.

Italian.—Grandgent's Italian Composition; Readings from Dante, Manzoni, Pellico.

French.

German.

English.

II.

For the Degree of Bachelor of Science.

The courses of study leading to the degree of Bachelor of Science are based upon the same schedule and are similar in extent, but differ in the amount of time given the characteristic or leading subject.

These courses are: First, a course in Biology [B]; second, a course in Chemistry [C]; third, a course in Geology [G]; and fourth, a course in Physics [P].*

* Bracketed initials signify that subjects so marked are required in the course thus indicated.

Differentiation begins with the Junior Year. Students entering for the Degree of Bachelor of Science must select the course to be pursued before that time and will be permitted to deviate from it only by Faculty vote.

FRESHMAN CLASS.

FALL TERM.

Chemistry.—Qualitative Analysis; Laboratory Courses with weekly recitations on the Chemistry of Metals.

†*French.*—Chassang's Grammar; Duval's *Histoire de la Littérature;* Corneille's *Horace;* or DeVigny's *Cinq Mars;* Herdler's Scientific French Reader; Outlines of French History to 1789.

Mathematics.—University Algebra, Part III.—Olney.

Rhetoric.—Hart's, with Lectures.

WINTER TERM.

Chemistry.—Qualitative Analysis finished; Organic Chemistry, three times a week.

Mathematics.—Geometry; Plane Trigonometry.

French.—Thier's *Bonaparte en Egypte;* Vacquerie's *Jean Baudry;* Masson's *Lyre Francaise;* Branson's *Everyday French;* French History from 1789 to 1848.

American Literature.—One hour each week.

Rhetoric.—Hart's, with Lectures.

SPRING TERM.

French.—Sandeau's *Mademoiselle de la Seiglière;* Effinger's *Sainte Beuve;* Dumas' *Les Trois Mousquetaires;* Branson's *Everyday French;* Gaston Paris' *Chanson de Roland;* French History since 1848.

Chemistry.—Qualitative Analysis.

Dynamic Geology.

American Literature.—One hour each week.

Rhetoric.—Hart's, with Lectures.

SOPHOMORE CLASS.

German.—Joynes-Meissner's German Grammar, (Lessons I–XXV); Brandt's German Reader; Dictation and Composition.

Mathematics.—Plane and Spherical Trigonometry; Olney's General Geometry begun.

Rhetoric.

---

† Second Year Course prescribed for Freshmen who elect French in the Senior Preparatory year.

WINTER TERM.

German.—Joynes-Meissner's Grammar; Schiller's *Wilhelm Tell:* Müller *Leitfaden zur Geschichte des deutschen Volkes;* Harris' German Composition; Dictation and Sight Reading.

Mathematics.—General Geometry and Differential Calculus; Lectures on the Integral Calculus, four hours a week.

Zoology.—Vertebrates, Lectures and Laboratory work, four hours a week.

English Literature.—Two hours a week.

Rhetoric.

SPRING TERM.

German.—Müller's *Leitfaden zur Geschichte des deutschen Volkes;* Riehl's *Burg Neideck;* Dictation and Sight Reading.

Zoology.—Invertebrates, Lectures and Laboratory Work.

Mathematics.—Surveying.

Rhetoric.—Essays and Orations

JUNIOR CLASS.

FALL TERM.

Comparative Anatomy and Histology.—[B].

Mineralogy.—[C—G].

Calculus. (Half Term); Physical Laboratory.—(Half Term). [P.]

Mechanics.—Recitations and Laboratory work; Lectures on Sound

Rhetoric.—Essays.

ELECTIVES.

German.—Freytag's *Doctor Luther:* Schiller's *Das Lied von der Glocke* and *Ballads;* Collar-Eysenbach's German Lessons throughout the year; Spanhoofd's *Deutsche Grammatik.*

Spanish.—Manning's Spanish Grammar; Knapp's Spanish Readings.

Botany.—Structural.

A Science.—Other than that prescribed.

WINTER TERM.

Neurology.—[B.]

Organic Chemistry.—Laboratory work. [C].

Physics—Magnetism and Electricity; Lectures and Recitations, Laboratory Work three times a Week. [P].

Logic.—Davis' Inductive and Deductive Logic.

Geology.—Physiographic. [G].

Rhetoric.—Essays; Studies in Shakespeare.

ELECTIVES.

German.—Lessing's *Minna von Barnhelm;* or Schiller's *Die Piccolomini;* Dippold's *A Scientific German Reader;* Composition and Dictation; Themes on German History.

Mathematics.—Bridge Construction.

Spanish.—Selections from Galdos and Valera; Lope de Vega and Calderon; Knapp's Readings, and Berlitz's Exercises.

A Science.—(Other than prescribed).

Laboratory Physics.—Electrical Measurements. [P].

Botany.—Bacteriology.

SPRING TERM.

Botany.—Cryptogams. [B-G].

Embryology.—Lectures and Laboratory Work. [B].

Chemistry—Laboratory; Advanced Quantitative. [C].

Physics.—Heat and Light; Lectures, Recitations, Laboratory Work. [P].

Astronomy.—Young's General Astronomy; Lectures. [Elective for B]

Rhetoric.—Orations.

ELECTIVES.

History.—Emerton's *Mediaeval Europe.*

German.—Goethe's *Hermann und Dorothea;* Von Sybel's *Die Erhebung Europas gegen Napoleon I;* Dictation and Composition.

A Science.—(Other than required).

English.—English Literature of the Nineteenth Century.

Botany.—Physiological.

Mathematics.—Strength and Resistance of Materials.

SENIOR CLASS.

FALL TERM.

Psychology.—Lectures.

English Literature.—Lectures and Select Readings.

History of Philosophy.—Weekly Lectures.

Geology.—[G].

Chemistry, Assaying, or Water Analysis.

Physics.—Electrical Engineering. [P].

An Elective [B].

WINTER TERM.

Ethics.—Lectures on Theoretical and Practical Ethics; Notes on the Phisophy of Ethics and the Moral Code.

History of Philosophy.—Weekly.

Physiological Psychology. [B].
Technological Chemistry.—[C].
Geology.—Lithology or Paleontology. [G].
Laboratory Physics.—[P].
Rhetoric.—Orations.

ELECTIVES.

Economics.

German.—Goethe's Prose ; History and Literature ; Dictation and Composition.

Italian.—Grandgent's Italian Grammar ; Harper's *Principia Italiana*, Part I., or Bowen's or Montague's Reader.

SPRING TERM.

Evidences of Christianity.—Purinton's Theism.

ELECTIVES.

History of Civilization.—Guizot.

International Law.

Italian.—Grandgent's Italian Composition ; Readings from Dante, Manzoni Pellico.

French.

German.

English.

Thesis in Science.

SCIENTIFIC FACULTY OF 1897-98.

The scientific faculty for the current year includes six men, besides electrician, engineer, instructors in the academic department, and janitors.

*JOHN L. GILPATRICK, A.M., Ph.D., Benjamin Barney Professor of Mathematics, was born in Granger, New York, January 12, 1845 He received his early education in the common schools of Granger and at the age of thirteen moved to Ohio with his parents. He graduated with the degree of B A., in 1867, from Kalamazoo, Mich , as valedictorian of his class. After teaching one year in the country schools he became superintendent of the public schools of Ft. Dodge, Iowa, Gosport, Ind., and Bowling Green, Ohio. He was Instructor in Mathematics in the University of Michigan from 1873 to 1874. Since 1874 he has occupied his present position in the chair of Mathematics. He is at present the senior member of the University Faculty and was for many years the University Treasurer. He is President of the Society of Civil Engineers of Ohio.

The work in his department embraces the following subjects:

Algebra An advanced course. *Geometry*. *Trigonometry*—Plane and *Spherical*. *General Geometry and Calculus*.

Instruction in Civil Engineering is given by actual field practice in Land Surveying, in Laying out Roads and Railroads, and in Leveling. Johnson's Plane Surveying and Henck's Field Book for Engineers are the text books used. The University is supplied with good instruments for field work.

A course in *Descriptive Geometry* is open to those who have had Elementary Algebra, Elementary Mechanical Drawing, and Plane and Spherical Geometry.

---

*The department of mathematics, pure and applied, is not now located in Barney Memorial Hall, but occupies several large and commodious rooms in College Hall, which were vacated by the other scientific departments when they moved to their new quarters in Memorial Hall. These rooms were remodeled and fitted up especially for the mathematical department and are well supplied with the best apparatus.

J. L. GILPATRICK, PH. D.

A. D. COLE, A. M.

W. G. TIGHT, M. S.

C. JUDSON HERRICK, M. S.

W. H. BOUGHTON, B. S.

H. C. McNEIL, B. S.

SCIENTIFIC FACULTY OF 1897-8

Principles of Mechanism—Recitations from text-book and solutions of problems in drawing room.

Analysis of Structures, Graphical and Analytical—Open to those who have had the mathematics of the Sophomore year and Mechanics.

Strength and Resistance of Material—Open to those who have had Analysis of Structures.

The work in Astronomy is at present in charge of this department. The subject as presented in Young's General Astronomy, supplemented by lectures, is offered. Moreover it is hoped that the department of Astronomy may soon be put upon an independent basis and furnished with a well equipped observatory.

It is to be hoped, also, that the department of mechanical engineering will be put upon an equal footing with the other scientific departments, by the appointment of a professor and the equipment of the necessary laboratories. The trustees have already shown an interest in the development of this work which is receiving so much attention and for which there is a real and growing demand among the students. Their efforts in this direction will certainly be appreciated by the patrons of the school and all those interested in the teaching of science in Denison University.

* * *

Alfred Dodge Cole, A.M., Henry Chisholm Professor of Chemistry and Physics, was born at Rutland, Vermont, December 18, 1861. He received his early education in the grammar and high schools of Beverly, Mass. He entered Brown University in 1880. In 1883 he received the Howell Premium "for highest grades in Mathematics and Physics," and was also appointed to the Oratio Latina at Junior Exhibition, and the first Junior elected to Phi Beta Kappa. He graduated from Brown as valedictorian of his class, with the A.B. degree, in 1884. After spending one year in post-graduate study at Johns Hopkins University, he took charge of the work in chemistry and physics at Denison University, which position he still occupies. He was a member of the building committee of Barney Memorial Science Hall, appointed by the trustees, and as he was constantly on the ground the great burden of inspecting the details of construction fell to his hands. This work he discharged with very great credit to himself and profit to the University.

During the school year of 1884-5 he pursued special studies in Physics in the University of Berlin. He is a member of the American Association for the Advancement of Science. Besides his publications in the Bulletin of the Scientific Laboratories of Denison University, given in the table of contents of that publication, he is the author of "*On the Refractive Index and the Reflecting Power of Water and Alcohol for Electrical Waves*," published in Annalen der Physik und Chemie, and the Physical Review; "*Electrical Waves in Parallel Wires*," in the Proceedings of the A. A. A. S and the Electrical World; "*Denson Univ. Laboratory Course in Electricity and Magnetism*," and others.

More than ten thousand dollars have recently been spent in equipping the laboratories of Physics and Chemistry for efficient work. They occupy fifteen rooms in Barney Memorial Hall.

The Courses in Physics include eight and one-half terms of work in Mechanics, Sound, Electricity, Heat, Light and Electrical Engineering. The work is largely laboratory work, and the laboratory is well supplied with modern apparatus and reference books. Five large power dynamos and motors, as many more small ones, ammeters, voltmeters, spectrometers, photometers, polariscopes, etc. of recent construction are available, and electrical current for light and power is furnished by a storage battery capable of furnishing nine horsepower. A shop, well furnished with power-driven machines for work in wood and metal, furnishes opportunity for construction of apparatus for special purposes.

The course in Chemistry includes ten terms of work in General Chemistry, Qualitative Analysis, Organic Chemistry, Assaying, Sanitary Chemistry, Electro-Chemistry and Technological Chemistry. Six analytical balances are provided for this work, also spectroscope, polariscope, storage battery for electrolytic work, three assay furnaces for testing ores, Beckmann's apparatus for determining molecular weights, Hempel's for gas analysis, etc. There are working desks, well supplied with gas and water, for sixty students, and a considerable collection of reference books.

Instruction in Chemistry is given by daily lectures and recitations during the spring to Freshman pursuing the course leading to the degree of Bachelor of Arts. Remsen's Chemistry and the Laboratory Manual of the same author are text-books used. Thorough experimental illustration in the class room is supplemented by individual work in the laboratory. Abundant apparatus and desk room, with water

ADVANCED PHYSICAL LABORATORY

and gas at each desk enable each student to verify for himself, experimentally, the fundamental facts of the science. Scientific development is secured by making demonstrated facts anticipate the theoretical treatment of the subject.

The study of qualitative and quantitative analysis, required in the course leading to the degree of Bachelor of Science and elective in other courses, includes laboratory work, three days a week during one year, weekly recitations on the chemistry of the metals during one term, and weekly recitations and discussions of methods in analysis throughout the course. The use of the spectroscope is taught. Both gravimetric and volumetric methods are used in quantitative work. Appleton, Thorpe, Caldwell and Fresenius are the authors most consulted in this department of work.

Scientific Freshmen and Classical Juniors (elective) have organic Chemistry three times a week in the Winter Term.

An elective course in Water Analysis or Assaying is offered in the Fall Term of the Junior Year, and later a term each in Advanced Organic, Advanced Quantitative Analysis and Technological Chemistry. Assay furnaces, combustion furnaces, Hempel's apparatus for gas analysis, etc., are available for this work.

In Physics instruction is given to the Junior class in Mechanics and Acoustics daily during the fall term and in Magnetism, Electricity, Heat and Light during the remainder of the year. Two hours a week are occupied wholly with class room exposition, experiment and recitation; three exercise are devoted chiefly to laboratory work. The laboratory experiments are chiefly quantitative, illustrating the principal methods employed in physical research. Detailed reports of the laboratory work are prepared by the students and handed in for criticism. These form the basis for occasional talks upon laboratory methods. Students are encouraged to devise and construct apparatus, and a machine shop equipped with two steam engines, lathes, dynamos, electric motors, etc., furnishes abundant means for such work. A regular class in apparatus construction is usually formed, and much useful apparatus has been made by these classes. Two and one-half terms of advanced laboratory work in the Junior and Senior years, and one of Electrical Engineering in the Senior year are offered as electives in the [P] Bachelor of Science course. Apparatus for the accurate measurement of physical quantities is being constantly secured, and continued effort will be made to provide instruments for accurate work. Pickering,

Kohlrausch, Stewart and Gee, Thompson, Sabine and Nichols, are the authors most consulted to supplement the laboratory guide of the professor in charge. Carefully prepared reading lists give ready access to the literature of special topics.

* * *

William G. Tight, M.S., Professor of Geology and Botany, was born March 12, 1865, at Granville, Ohio, where he received his education in the public school, preparatory to entering Denison in 1881. He graduated with the degree of B.S. in 1886, having devoted especial attention to science. He received his M.S. degree from Denison in 1887, and received appointment as Instructor in Science in the academic department. In 1889-92 he occupied the position of Assistant Professor of Geology and Biology and had full charge of the work of the departments. During the summer term of 1888 and the winter term of 1893 he pursued special studies in Harvard University. He is a member of the American Association for the Advancement of Science, and The Geological Society of America. Also President of the Ohio State Academy of Science and Permanent Secretary of the Denison Scientific Association. He has been editor of the Bulletin of the Scientific Laboratories of Denison University since 1889. His numerous contributions to scientific literature have mostly appeared in the Bulletin, the titles of which will be found in the tables of contents which are given further on in this volume.

He is an amateur photographer of years experience and has charge of the photo-engraving department.. All of the cuts used in illustration of this volume and most of those of the Bulletin of Scientific Laboratories and Journal of Comparative Neurology and the other University publications are made by him in the department of photography and engraving.

The Department of Geology occupies several large laboratories in Barney Memorial Hall. A good equipment of lithological lathes, microscopes, models, maps and other apparatus is furnished.

The department library contains several hundred volumes and a large collection of recent literature.

The courses of instruction include Physical Geography, Structural and Dynamical Geology, Paleontology, Lithology, Mineralogy, Physiography, and Economic Geology. Special attention is given to laboratory and field work.

BOTANICAL LABORATORY

A large museum containing type forms of fossils, suites of sedimentary, igneous and metamorphic rocks, and illustrative material in dynamical and structural geology forms an important part of the equipment.

The Bulletin of the Scientific Laboratories, published under the auspices of the Denison Scientific Association, furnishes means for publication of original work.

The department of Botany which occupies several well equipped laboratories and includes a large herbarium is at present under the charge of the department of Geology.

In Geology.—In the spring term of the Freshman year scientific students begin the study of Dynamical and Structural Geology. Dana's Manual of Geology is used in the text work, which is supplemented by lectures, laboratory and field work. This is followed by a term's work in Determinative Mineralogy. The work is largely confined to the laboratory, and embraces blow-pipe analysis, the elements of crystallography, and economic mineralogy. Dana's Manual and Brush's Determinative Mineralogy, with other reference books, are used.

In the winter term Junior year geological students are given a course in physiographic geology which includes principally topographic work.

In the fall term of the Senior year Historical Geology is studied. Dana's Manual is used as a text and the student devotes much time to field work and the solving of assigned problems of local geology.

In the winter term a course in Applied and General Geology varies with the exigencies arising. The course usually embraces the study of lithology, and the application of geology to the arts. Stratified rocks are studied with reference to their microscopic peculiarities and economic application. Metamorphic and igneous species are then studied by means of thin sections and the polarizing microscope. The text books employed are Rutley, Rosenbusch, and Hussack's Tables. Laboratory practice in Paleontology is sometimes substituted.

In the spring term a course in field geology includes the solution of original problems in local geology.

The Classical student may elect a course in General Geology in the fall term of the Senior year.

In Botany.—In the fall term, Junior year there is offered an elective term of structural Botany, which includes a study of the histology of vegetable tissue. In the winter term, Junior year, a couse in Bac-

teriology may be elected. Sternberg's Manual forms a basis for the term's work, which consists largely of laboratory practice.

In the spring term, Junior year, a general course in Cryptogamic botany includes the study of types and is mostly microscopic laboratory work.

In the spring term there is offered also, as an elective, a course in general plant physiology and chemistry.

Standard texts are used in all the work and the botanical laboratory is well supplied with reference works of highest authority.

* * *

C. Judson Herrick, M.S , Assistant Professor of Zoology, was born Oct. 6, 1868, at Minneapolis, Minn., where he received his elementary schooling. In 1885 he entered the Preparatory Department of Denison University, continuing his studies at this place nearly through his Sophomore year. He then entered the University of Cincinnati, from which he took the degree of Bachelor of Science in 1891.

He was appointed Instructor in Natural Sciences in Granville Academy, 1891-2 ; Professor of Natural Sciences, Ottawa University, 1892-3 ; Fellow in Biology in Denison University, 1893-5 ; Instructor in Biology, Denison University, 1895-6; University Scholar in Biology, Columbia University, 1896-7 ; Associate in Comparative Neurology, Pathological Institute of the New York State Commission in Lunacy, 1897–; Assistant Professor of Zoology, Denison University, 1897–. He took the degree of M.S. from Denison University in 1895.

Exclusive of papers in the Journal of Comparative Neurology and the University Bulletin, elsewhere noted, he has written the following articles :

Résumé of Recent Advances in the Study of the Nervous System, Transactions of the Kansas Academy of Science for 1892.

The Correlation between Specific Diversity and Individual Variability, as Illustrated by the Eye-muscle Nerves of the Amphibia. Proc. 7th. Annual Session Assoc. American Anatomists, 1895.

Nature Studies as a Preparation for Advanced Work in Science. Ohio Educational Monthly, Vol. XLVI, No. 4, April, 1897.

The Cranial Nerve Components of Teleosts. Anatomischer Anzeiger, Bd. XIII, No. 16, 1897.

Report upon a Series of Experiments with the Weigert Method as applied to Fish Tissues. New York State Hospitals Bulletin, 1898.

HISTOLOGICAL LABORATORY

With C. L. Herrick. Articles in the Baldwin Dictionary of Philosophy and Psychology. [In preparation.]

In Zoology the preparation required is such as is usually afforded in high and preparatory schools, including an elementary course in Physiology and Hygiene, and, for scientific students, a second term in Human Anatomy and Physiology, and a term's work in Botany.

In the Sophomore year the winter term is devoted to Vertebrate Zoology, the work consisting of lectures and recitations on the structure and classification of vertebrates supplemented by demonstrations and dissections in the laboratory. The course is intended as a general introduction to the following courses in Zoology and Paleontology. Classical students use Martin's "Human Body" during the corresponding term. In the spring term scientific students take up the practical study of the invertebrates, the laboratory course being accompanied by lectures on classification and the more fundamental biological problems.

The biological section of the scientific Juniors devotes the fall term to the Comparative Anatomy and Histology of vertebrates, especial attention being paid to the cultivation of the most recent methods in the microscopical examination of tissues. The course in Neurology offered to the Juniors in the winter term aims not only to impart a thorough knowledge of the anatomy and physiology of the nervous system, but to develop some of the practical hygienic and pedagogical applications. The student is assisted in the independent use of literature and introduced to the methods of biological research as applied to the morphological and practical problems of Neurology. In the spring term the same students take up Elementary Embryology, especial attention being given to problems of histogenesis and the functions of the cell in health and disease.

In the winter term of the Senior year, a course in Physiological Psychology is required of biological scientific students and is elective for others. Students expecting to take this course are strongly advised to take the Junior Neurology. After a course of lectures outlining the field, much of the time is devoted to a laboratory study of special topics, such as sensation, perception, attention, choice, the expression of emotion, etc. Kymograph, chronoscope and other necessary apparatus are supplied and well equipped machine shops give opportunity for the construction of additional pieces.

The courses in Biology are designed to bring the student face to face with nature and to encourage independence and originality of

thought. The laboratories are well equipped with compound microscopes and microtomes of modern construction, together with incubators and other necessary adjuncts for instruction and research.

The "Journal of Comparative Neurology," now in its eighth volume, is published quarterly from the department of Zoology, and affords an avenue of publication for the researches conducted in the neurological laboratory.

* * *

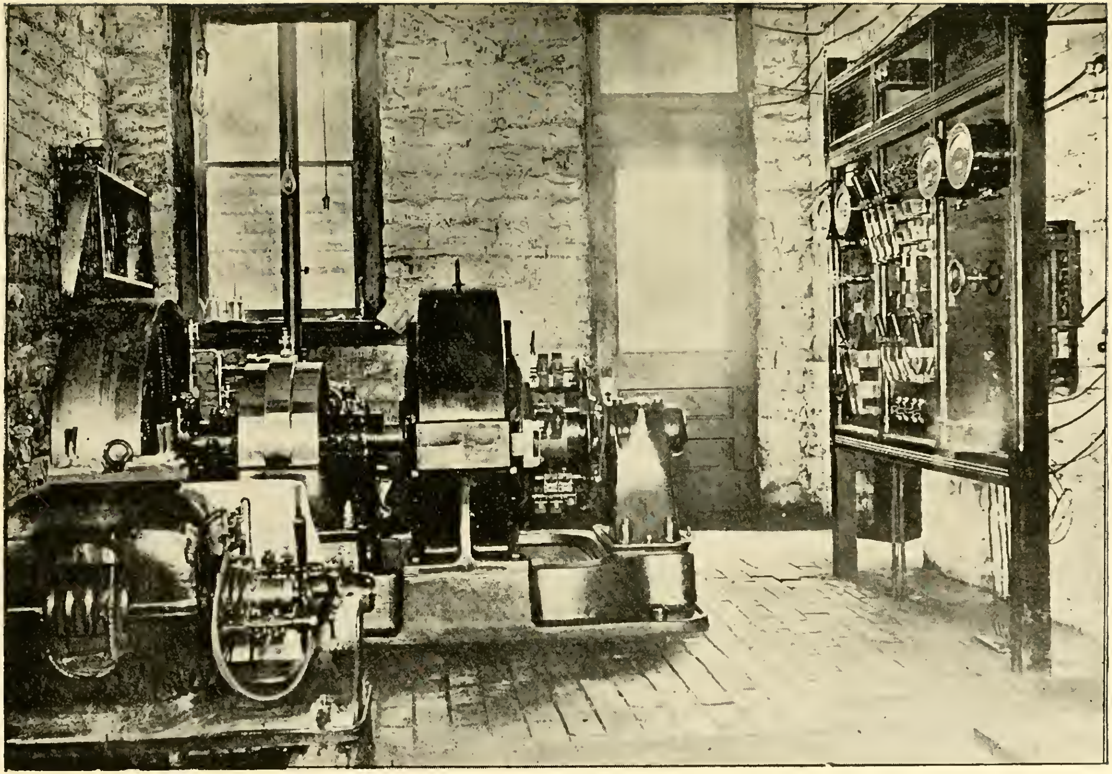
WILL H. BOUGHTON, C.E., Instructor in Mathematics and Natural Science, was born at Bowling Green, O., May 24th, 1867. He received his early education in the public schools of Norwalk, Ohio.

From 1889 to 1891 he attended Denison University. In 1893 he graduated with the degree B.S. from the Civil Engineering Course of the University of Michigan and has since earned the second degree of Civil Engineer by graduate work in the same institution.

In engineering work he has been employed as Assistant Engineer Maintenance of Way for the C. C. C. & St. L. Ry., St. Louis Division; Structural Draftsman for the New Jersey Steel and Iron Company, Trenton, N. J.; Pittsburg Bridge Company, Pittsburg, Pa.; Brown Hoisting and Conveying Machine Company, Cleveland, Ohio. In 1894 he was elected to his present position as Assistant in the department of Mathematics under Professor J. L. Gilpatrick.

* * *

COLVER H. MCNEIL, Instructor in Chemistry and Physics was born October 2d, 1866, near Winchester, Adams County, Ohio. He attended country school and completed the High School course at Winchester. After spending some months in the study of anatomy and physiology with a physician, he taught for the next five years in the public schools and in North Liberty Academy. Two summers were spent in attendance upon a Teachers' Normal School. In 1893 he entered Denison University and graduated with the degree of B.S. in 1896. During the summer of that year he pursued special work in chemistry at Harvard University and in the fall entered upon his duties as assistant to Professor A. D. Cole in Chemistry and Physics.



ENGINE AND DYNAMO ROOM OF THE POWER AND LIGHT PLANT

THE DENISON SCIENTIFIC ASSOCIATION.

The Denison Scientific Association was organized April 16th, 1887 by Professor C. L. Herrick. By his invitation a number of the professors and students met in his recitation room in College Hall. Professor Herrick presented to the meeting the plans for organization. A committee on constitution and by-laws was appointed and later reported the following:

CONSTITUTION AND BY-LAWS OF DENISON SCIENTIFIC ASSOCIATION.

CONSTITUTION.

ARTICLE I.

NAME.

This Society shall be called "The Denison Scientific Association."

ARTICLE II.

AIMS.

(a) To afford opportunity for the interchange of ideas by those interested in the various sciences.

(b) To collect, record and disseminate information bearing on the sciences.

(c) To stimulate interest in local natural history and preserve specimens illustrating the same.

ARTICLE III.

OFFICERS.

The officers shall be—

First—The President, who shall preside at all meeting and exercise the powers vested in the presiding officer.

Second—The Vice President, who shall preside in the absence of the president.

Third—The Recording Secretary, who shall preserve records of all business transacted and keep such records of proceedings and communications as the Association shall vote.

Fourth—The Treasurer, who shall collect and hold in trust all moneys belonging to the Association and pay the same only upon vote of the Association, receiving a written order signed by the president and secretary.

Fifth—The Permanent Secretary, who shall be an instructor in some branch of science in Denison University, and who shall be acting corresponding secretary and ex-officio curator and special committee on publication. The permanent secretary shall hold office subject only to resignation.

Sixth—The Executive Committee. The officers of the Association shall constitute an executive committee, which shall have power to act in the name of the Association in the absence of specific instructions.

Seventh—Sections It shall be rulable for the president to announce, at the beginning of each year, sections of the Association charged with the special superintendence of certain lines of investigation. The chairmen of these sections may be held responsible for periodical reports on the subject assigned. The sections shall include the the following subjects: 1st, Geology and Mineralogy; 2d, Biology and Microscopy; 3th, Chemistry, Physics and Astronomy; 4th, Philology, Ethnology and Explorations.

ARTICLE IV.

TERMS OF OFFICE.

All officers, except the permanent secretary, shall be elected at the first regular meeting after the opening of the fall term of Denison University.

ARTICLE V.

MEMBERSHIP.

Students of Denison University shall become members by signing the Constitution and paying the regular dues. All other candidates for membership must have their names proposed by two active members and be duly elected by a majority vote of those present at some regular meeting. Members of the Faculty shall be ex-officio members, but shall be entitled to the privileges of active membership, only upon payment of fees and dues. No persons shall be elected honorary members, except on their request or expressed permission. All active and honorary members become entitled to receive the annual publications the Association, and to the use of its library.

BY-LAWS.

ARTICLE I.

MEETINGS.

The Association shall meet for the election of officiers on the first Saturday evening of the school year and shall hold bi-weekly meetings regularly thereafter during term time, at which any routine business may be transacted. Meetings may be called at the request of five members and due notification, at which meetings any business, aside from the election of officers or a motion to amend the Constitution, may be in order. Special meetings may be held, subject to the call of the president; but no business of record may be transacted.

ARTICLE II.

FEES.

All active members shall pay a fee of $.50 for one term, or $1.00 for one year, or $3.00 for four years, or $25 00 for life membership; and it it shall not be permissible to levy any other tax or assessment upon the members, except by mutual consent of all concerned.

ARTICLE III.

ORDER OF BUSINESS.

The usual order of exercises shall be :

1. Roll Call.
2. Reading of Minutes.
3. Proposals for Membership.
4. Reports of Committees.
5. Unfinished Business.
6. New Business.
7. Secretary's Report on Communications.
8. Reports of Chairmen of Sections.
9. Regular Program.
10. Informal Discussion.

Election of officers shall be construed as unfinished business.

The report of the committee was at once adopted and the organization effected with the following as charter members :

C. L. Herrick, W. H. Johnson, A. D. Cole, J. L. Deming, C. P. Jones, E. H. Castle, H. L. Jones, J. E. Woodland, D. E. Munro, W. G. Tight, T. A. Jones, A. T. VonShulz, W. E. Castle, C. L. Payne, W. H. Herrick, C. Judson Herrick, Aug. F. Foerste, E. S. Clark, C. R.

Hervey, E. A. Deming, W. H. Cathcart, Geo. D. Shepardson, Chas. Chandler, L. E. Akins, John Thorne, Enoch J. Price, Chas. T. Atwell.

As the Association increased in its membership and work it was found necessary to add two new sections to the original list so that at present the sections of the association are:

1st, Geology and Paleontology; 2d, Photography; 3d, Biology and Microscopy; 4th, Chemistry and Mineralogy; 5th, Physics and Astronomy; 6th, Philology, Ethnology and Explorations; 7th, Pure and Applied Mathematics. Each section leader is responsible for the program of the meeting at which his section has the principal papers. It is customary also for each section leader to make a brief report at each meeting of the progress in his department for the two weeks preceeding. In this way a résumé of the scientific literature in every department for the interim between meetings is reported at each meeting, while each section in succession is represented by more extended reports and original papers. The benefits thus gained are very great. The Association stimulates work in every department and its members are kept in touch with work being done in other lines than their own, thus acquiring a large amount of general knowledge. Before the organization of the Association Professor C. L. Herrick had begun the publication of the Bulletin of the Scientific Laboratories and as permanent secretary of the Association he also acted as editor of the Bulletin, which he placed in the hands of the Association as its official organ of publication. Thus it was that the Bulletin of the Laboratories passed under the auspices of the Association with its permanent secretary as editor. Professor Herrick remained permanent secretary of the Association until 1889, when Professor Tight was elected to the position made vacant by Professor Herrick's absence from the University.

MINERALOGICAL LABORATORY

SCIENTIFIC PUBLICATIONS.

Closely connected with the work of instruction in the class-room and laboratory is the work of investigation and research. This is being done by both professors and students in the various departments. Pupils are especially encouraged in this kind of work, as it is believed that in no other way can the powers of independent thought be so well developed in the student. The results obtained are of value also to science at large and the means for publication at present offered are the Bulletin of the Scientific Laboraties of Denison University and the Journal of Comparative Neurology.

THE BULLETIN, as already stated, was founded by Professor C. L. Herrick and the first volume appeared in December, 1885. After the organization of the Denison Scientific Association in 1887, Professor Herrick made the Bulletin the official organ of the Association, but he continued as its editor until 1889. Since that time it has been edited by Professor Tight. The work of the Bulletin can best be shown by the list of articles which have appeared in it, which is given by volumes in the following tables of contents:

VOLUME I.

With 15 Plates 5 Cuts.

Volume II.

With 15 Plates and 2 Cuts.

Part I.

Part II.

Volume III.

With 13 Plates.

Part I.

Part II.

Volume IV.

With 15 Plates.

Part I.—Laboratory Results.

PART II.—Educational and Literary.

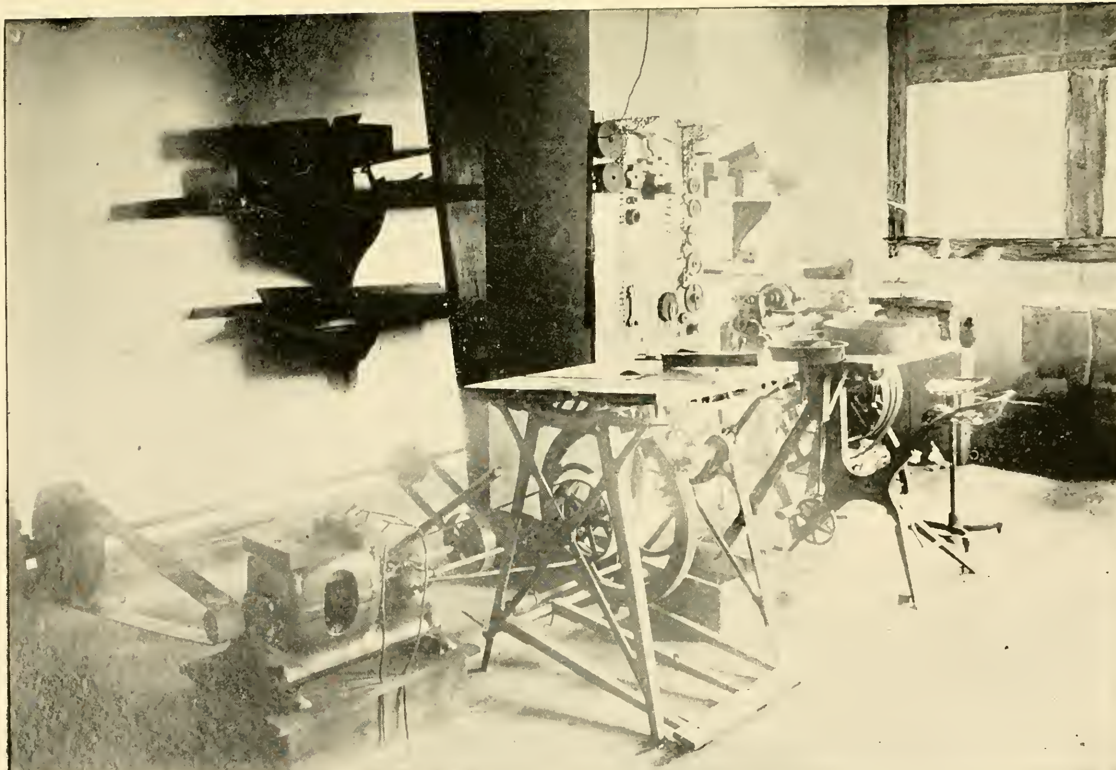
VOLUME V

With 21 Plates.

VOLUME VI.

With 12 Plates.

PART I.



SPECIAL SHOP OF BIOLOGICAL DEPARTMENT

PART II.

With 11 Plates and 5 Cuts.

Vol. X will include, besides the matter herein contained, a supplement consisting of a complete index to the first ten volumes. It has been decided hereafter to publish the Bulletin by articles, making a volume to include as nearly 500 pages as is convenient and to close with an index. The advantages of this method are believed to outweigh those of the present form of publication.

Besides furnishing a ready and convenient means of publication, the Bulletin is also of great value to the Scientific Association and the University through the large amount of valuable scientific literature which is received in exchange and part of which could be secured in no other way. It is not possible in the limits of this article to give any adequate list of the material which has been added already to our library in this way. Some idea can be gained however from the exchange list. This will show also the wide distribution which the Bulletin receives Most of these organizations favor us with their entire list of publications, often consisting of several series.

EXCHANGE LIST OF THE BULLETIN.

AMERICA (NORTH.)

UNITED STATES.

ALBANY, N. Y.,

State Library.

AMHERST, MASS.,

Amherst College, Scientific Department.

BALTIMORE, MD.,

Biological Laboratories, Johns Hopkins University.

Boston, Mass.,
American Academy of Arts and Sciences.
Boston Society of Natural History.
Journal of American Ethnology and Archæology.
Public Library.

Bloomington, Ind.,
Indiana University.

Brookville, Ind.,
Brookville Society of Natural History.

Cambridge, Mass.,
Museum of Comparative Zoology.
Peabody Museum of American Archæology aud Ethnology.

Chicago, Ill.,
American Antiquarian.
University of Chicago.

Chapel Hill, N. C.,
Elisha Mitchell Scientific Society.

Columbus, O.,
Meterological Bureau.
Geological Survey.
Horticultural Society.

Cincinnati, O.,
Society of Natural History.

Columbia, Mo.,
State University.

Crawfordsville, Ind.,
Botanical Gazette.

Davenport, Ia.,
Davenport Academy of Natural Science.

Fort Collins, Cal.,
State Agricultural College.

Iowa City, Ia.,
State University Laboratories.

Indianapolis, Ind.,
Geological Survey.

Ithaca, N. Y.,
Cornell University.

LINCOLN, NEB.,

Nebraska University.

LAWRENCE, KAS.

Kansas University Quarterly.

MADISON, WIS.,

Natural History Society of Wisconsin.

State University of Wisconsin.

Wisconsin Academy of Arts, Science, and Letters.

MERIDEN, CONN.,

Scientific Association.

MILWAUKEE, WIS.,

Public Museum.

Natural History Society.

MINNEAPOLIS, MINN.,

Academy of Natural Science.

American Geologist.

Geological and Natural History Survey.

University of Minnesota.

NEW HAVEN, CONN.,

Connecticut Academy of Arts and Sciences.

NEW YORK, N. Y.,

New York Botanical Garden.

Academy of Science.

Public Library.

American Museum of Natural History.

Microscopical Society.

Torry Botanical Club.

OBERLIN, OHIO,

Bulletin of Oberlin Laboratories.

PHILADELPHIA, PENN.,

Academy of Natural Science.

American Philosophical Society.

ROCHESTER, N. Y.,

Academy of Science.

University of Rochester.

SAN FRANCISCO, CAL.,

California Academy of Science.

SALEM, MASS.,
Essex Institute.
Peabody Academy of Science.

SANTA BARBARA, CAL.,
Society of Natural History.

SPRINGFIELD, MASS.,
Historical Library.

SPRINGFIELD, ILL.,
Geological Survey.

ST. LOUIS, MO.,
Academy of Science.
Missouri Botanical Gardens.

TOPEKA, KAS.,
Kansas Academy of Science.
Washburn Laboratories of Natural History.

TRENTON, N. J.,
Trenton Natural History Society.

TUSCALOOSA, ALA.,
Geological Survey.

URBANA, ILL.,
State Laboratory of Natural History.

WASHINGTON, D. C.,
Geological Survey.
National Museum.
National Academy of Science.
Philosophical Society.
Department of Agriculture.
Smithsonian Institution.
Library Surgeon General's Office.

CANADA.

HALIFAX (*Nova Scotia*,)
Nova Scotia Institute of Science.

MONTREAL (*Quebec*,)
The Canadian Record of Science.
Natural History Society.
Royal Society of Canada.

TORONTO (*Ontario,*)
Canadian Institute.

MEXICO.

MEXICO,
Sociedad Mexicana de Historia Natural (*Mexican Natural History Society.*)
Sociedad de Geographia y Estadistiea de la Republica Mexicana.

AMERICA (SOUTH).

ARGENTINE REPUBLIC.

BUENOS AIRES,
Museo Nacional Annals (*Annals of National Museum.*)
Sociedad Cientifica Argentina (*Argentine Scientific Society*)

BRAZIL.

RIO DE JANEIRO,
Museo Nacional (*National Museum.*)

CHILE.

SANTIAGO,
The University.

URUGUAY.

MONTIVIDEO,
Museum of Montivideo.

ASIA.

JAPAN.

TOKIO,
Tokio Daigaku (Imperial University.)

AUSTRALIA.

NEW SOUTH WALES.

SIDNEY,
Geological Survey.
Linnean Society of New South Wales.
Australian Museum.

SOUTH AUSTRALIA.

ADELAIDE,
Royal Society of South Australia.

VICTORIA.

MELBOURNE,
Royal Society of Victoria.

EUROPE.

AUSTRIA-HUNGARY.

GRATZ (*Styria*,)

Der Naturwissenchaftliche Verein für Steirmark (*Society of Natural Science.*)

PRAGUE (*Bohemia*,)

Kaiserliche böhmische Gesellschaft der Wissenschaften (*Royal Bohemian Society of Science.*)

VIENNA (*Austria*,)

Kaiserliche Akademie der Wissenchaften (*Imperial Academy of Science.*)

BELGIUM.

BRUSSELS,

Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique (*Royal Academy of Sciences, Letters and Fine Arts of Belgium.*)

Musée Royal d'Historie Naturelle de Belgique (*Royal Museum of Natural History of Belgium.*)

DENMARK

COPENHAGEN,

Kongelige Danske Videnskabernes Selskab (*Royal Danish Society of Sciences.*)

FRANCE.

ANGERS,

Société d'Etudes Scientifiques (*Society of Scientific Studies.*)

CHERBOURG (*Manche*,)

Société Nationale des Sciences Naturelles et Mathematiques de Cherbourg (*Society of Natural Sciences and Mathematics of Cherbourg.*)

NANCY,

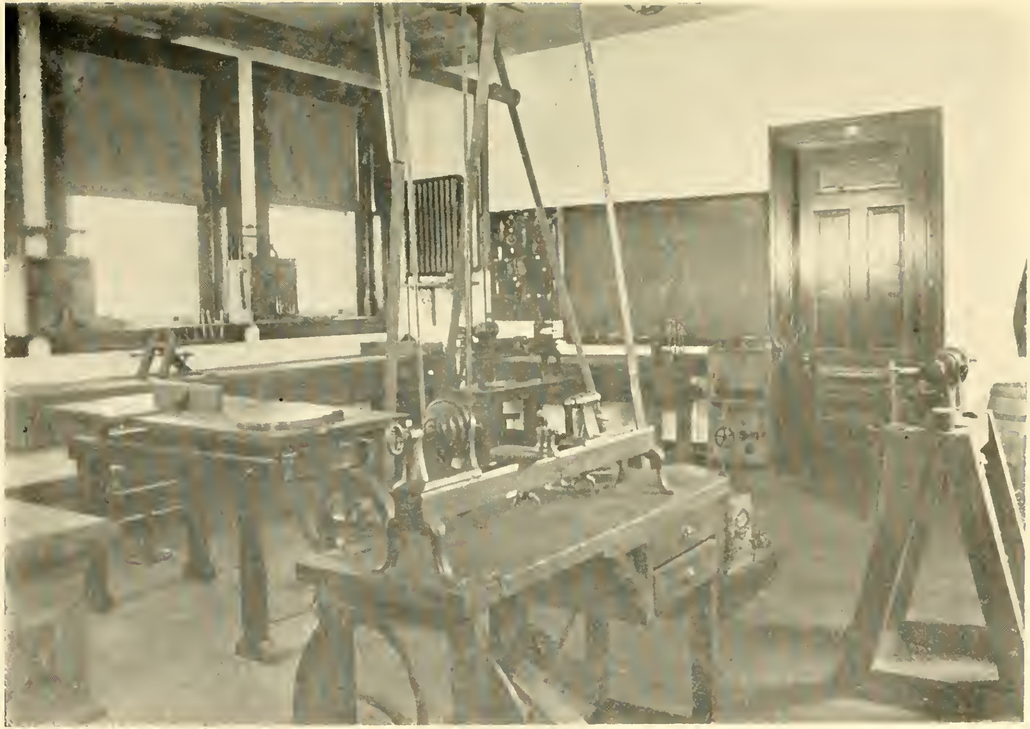
Société des Sciences de Nancy (*Society of Sciences of Nancy*)

PARIS,

Société Zoologique de France (*Zoological Society of France.*)
Société Geologique de France (*Geological Society of France.*)
Société Anatomique de Paris (*Anatomical Society of Paris.*)

ROUEN,

La Société des Amis des Sciences Naturelles (*The Society of the Friends of Natural Science.*)



SHOP

GERMANY.

BERLIN (*Prussia.*)

Königliche (Preussiche) Akademie der Wissenchaften (*Royal Prussian Academy of Sciences.*)

BREMEN (*Germany,*)

Naturwissenschaftlicher Verein (*Society of Natural Sciences.*)

DRESDEN (*Saxony,*)

Gesellschaft für Natur- und Heil-kunde (*Society of Natural and Medical Sciences.*)

FRANKFORT-AM-MAIN,

Senckenbergische Naturforschende Gesellchaft (*Senckenberg Naturalists' Society.*)

GÖTTENGEN (*Prussia,*)

Königliche Gessellschaft der Wissenschaften (*Royal Society of Sciences.*)

HALLE-AN-DER-SAALE (*Prussia,*)

Kaiserliche Leopoldini Carolina Akademie der Deutschen Naturforscher (*Imperial Leopold-Carolus Academy of German Naturalists.*)

Naturforschende Gesellschaft (*Naturalists' Society.*)

HEIDELBERG (*Baden,*)

Naturhistorisch-Medicinischer Verein (*Society of Natural and Medical Sciences.*)

KÖNIGSBERG-IN-PRUSSEN (*Prussia,*)

Die Königliche Physikalisch Oekonomische Gessellschaft (*Royal Physico-Economical Society.*)

MUNICH (*Bavaria,*)

Königlich Baierische Akademie der Wissenschaften (*Royal Bavarian Academy of Sciences.*)

GREAT BRITAIN AND IRELAND.

ENGLAND.

BRISTOL,

Naturalist Society.

BATH,

Journal of Microscopical Society.

CAMBRIDGE,

Philosophical Society.

LONDON,

Biblographical Bulletin.

Geological Survey of the United Kingdom.

Patent Office Library.

Society for Psychical Research.

MANCHESTER,

Literary and Philosophical Society.

IRELAND.

DUBLIN,

Royal Dublin Society.

Royal Irish Society.

SCOTLAND.

EDINBURGH,

Royal Society of Edinburgh.

GLASGOW,

Natural History Society of Glasgow.

ITALY.

NAPLES,

Reale Academie delle Scienze Fisiche e Mathematiche (*Royal Academy of the Physical and Mathematical Sciences.*)

Sociéta Reale di Napoli (*Royal Society of Naples.*)

LUGANO,

Société Helvetique des Sciences Naturelles (*Helvetian Society of Natural Sciences.*)

ROME,

Officio Geologico (*Geological Office.*)

SOLOTHURN,

Naturforschende Gesellschaft (*Society of Naturalists.*)

TURIN,

R. Academia della Scienza (*Royal Academy of Science.*)

Musei di Zoologia ed Anatomia Comparata delle R. Università di Torino (*Museum of Zoology and Comparative Anatomy of the Royal University.*)

NORWAY.

CHRISTIANA,

Norske Geologiske Undersaegelse (*Norwegian Geological Survey.*)

RUSSIA.

MOSCOW,

Imp. Moskofskoie Obshchestyo-Ispytatetei (*Imperial Society of Naturalists of Moscow.*)

RIGA,

Obschchestyo Iestestyo-Ispytateleie (*Society of Naturalists.*)

ST. PETERSBURG,

Comiti Geologique (*Geological Survey.*)

Institute des Mines (*Institute of the Mines.*)

Russisch-Kaiserlichen Minerologischen Gessellschaft (*Royal Mineralogical Society.*)

KIEW,

Société des Naturalistes (*Society of Naturalists.*)

SPAIN.

MADRID,

Real Academia de Sciencias de Madrid (*Royal Academy of Sciences of Madrid.*)

SWEDEN.

LUND,

Acta Universitatis Lundensis (*Royal University of Lund.*)

STOCKHOLM,

Kongligi Svenski Vetenskaps Akademien (*Royal Swedish Academy of Sciences.*)

Sveriges Geologiska Undevsökning (*Swedish Geological Institute.*)

UPSALA,

Kongliga Vetenskaps Societaten (*Royal Society of Sciences.*)

SWITZERLAND.

BASEL,

Naturforschende Gesellschaft (*Society of Naturalists.*)

BERN,

Naturforschende Gesellschaft (*Society of Naturalists.*)

The Journal of Comparative Neurology was founded in 1891 by C. L. Herrick, then Professor of Biology in the University of Cincinnati. It is devoted to the study of the nervous system of man and the lower animals so far as these studies are conducted by the comparative method in the broadest sense of that term, a field not occupied by any other periodical in any language. Its pages are chiefly occupied with original contributions to science and these are fully illustrated with many plates. An important feature, however, is the review department by means of which the reader is kept in touch with the latest and best current literature both in this country and abroad. Due attention is given to the psychological bearing of neurological discoveries and to the data of comparative psychology.

In 1892, upon Professor Herrick's return to Denison Universtty, the Journal became one of the university publications and since then an annual grant has been made for its support. In 1894, Professor Herrick's brother, C. Judson Herrick, became one of the editors and has since that time been the business manager. In 1896 the editorial staff was reorganized with Professor C. L. Herrick as Editor-in-chief and Oliver S. Strong of Columbia University and C. Judson Herrick of Denison University as Associate Editors. In 1898, beginning with the first number of Vol. VIII, there have been added to the editorial staff a number of Collaborators, all men of eminence in their respective departments and representing leading institutions in this country and Europe. At the present writing the list of Collaborators is not yet completed, but the following may now be announced:

Henry H. Donaldson, Ph.D., *Professor of Neurology, University of Chicago;* Growth and regeneration of nervous organs.

Professor Ludwig Edinger, *Frankfort, a M.*, Collaborator for Germany.

Professor A. van Gehuchten, *University of Louvain, Belgium;* Collaborator for France and Belgium.

G. Carl Huber, M.D., *Assistant Professor of Histology and Embryology in the University of Michigan;* The sympathetic system and the peripheral nervous system.

B. F. Kingsbury, Ph.D., *Instructor in Microscopy, Histology and Embryology, Cornell University and the New York State Veterinary College;* Morphology of the lower vertebrates (Ichthyopsida).

Frederic S. Lee, Ph.D., *Adjunct Professor and Demonstrator of*

ADVANCED CHEMICAL LABORATORY

Physiology, College of Physicians and Surgeons, New York City; Physiology of the nervous system.

Adolf Meyer, M.D., *Docent in Psychiatry, Clark University, and Assistant Physician to the Worcester Lunatic Hospital;* Human neurology.

The exchange list of the Journal includes may publications not received by the Bulletin.

The original articles which have appeared in the seven volumes now completed are indicated in the Table of Contents below.

Volume I, 1891.

MARCH.

JUNE.

OCTOBER.

DECEMBER.

Volume II, 1892.

FEBRUARY.

MAY.

SEPTEMBER.

DECEMBER.

DECEMBER, [Supplement].

VOLUME III, 1893.

MARCH.

JUNE.

SEPTEMBER.

DECEMBER.

Volume IV, 1894.

APRIL.

JULY.

SEPTEMBER.

DECEMBER.

ORGANIC CHEMICAL LABORATORY

Volume V, 1895

MARCH.

JULY.

DECEMBER. Double Number.

Volume VI, 1896.

MARCH.

JUNE.

DECEMBER. Double Number.

VOLUME VII, 1897.

No. 1. APRIL.

No. 2. SEPTEMBER.

Nos. 3 and 4. MARCH, 1898.

NORTH FRONT BARNEY MEMORIAL SCIENCE HALL

THE GIFT OF BARNEY MEMORIAL SCIENCE HALL.

Early in the nineties, it became evident that the pioneer labors of Professor Osbun of the department of Physics and Chemistry and Professor C. L. Herrick of the department of Natural History, were bringing forth abundant fruit and that the scientific departments of the University were displaying a new life and energy. This was seen in many things, but especially in the large number of students who sought the courses in science. Hitherto the number of scientific students was relatively small. Now they were increasing on every hand. Indeed, so rapid was this growth that it overtaxed the equipment and became a source of embarrassment to the professors. For a certain laboratory capable of accommodating twenty students, there were fifty applicants. Every thing became over-crowded and the necessity for a new Science Hall became apparent. The matter was laid before the Trustees and a committee was appointed to solicit funds for the erection of a suitable building. This committee did some valuable work, but results were not readily reached.

The commencement of 1892 drew near, and still there was no provision for the building. Early in May of this year, the president of the University presented the facts of the case to Mr. E. J. Barney, of Dayton, and asked his advice. He at once advised that a competent architect be sought and preliminary sketches of such a building as was needed be prepared and presented to the Trustees at their approaching meeting in June. Messrs. Peters and Burns, architects, of Dayton, O., were engaged to prepare the work as suggested. This was all that was known at that time of Mr. Barney's generous designs. Commencement time came, and still there was no provision for the much needed building. At the annual meeting of the Trustees there was a general feeling of anxiety because of the situation. But Mr. Barney greatly relieved and gratified the Board by coming forward with a generous offer of $40,000 for the erection of a Science Hall. The offer was promptly accepted and a Building Committee appointed to

take charge of the work of construction. All were filled with rejoicing when, two years later, the handsome and commodious building was publicly dedicated to the noble purposes for which it had been erected. During the ceremonies of dedication, Mr. Albert Thresher, of Dayton, acting on behalf of Mr. Barney and the Building Committee, presented the keys of the building, with well chosen words, to Dr. H. F. Colby, President of the Board of Trustees. Dr. Colby responded appropriately and felicitously. The dedicatory address was given by Prof. J. J. Stevenson, Ph.D., LL.D., of the University of New York, and a most eventful occasion in the history of Science at Denison University was happily closed, the only regret being that the generous donor of the building was unable to be present.

E. J. BARNEY, ESQ.

EUGENE J. BARNEY.

The donor of Science Hall, Mr. Eugene J. Barney, is the eldest son of Eliam E. and Julia (Smith) Barney, and was born at Dayton, Ohio, Frebruary 12, 1839. His education was received in the public schools of his native city and at Rochester University. Soon after leaving college he turned his attention to business. purchasing an interest in what was then known as the Barney & Smith Car Works. He was gradually promoted through various positions of trust connected with this large establishment and upon the death of his father in 1880 became its president. His sound judgment and ripe experience have made him a valuable counsellor in business circles and he is officially connected with a large number of important corporations at home and elsewhere.

Mr. Barney lives in an elegant home in the central portion of the city, but still retains his membership in the Linden Avenue Baptist Church, which he helped to establish as a mission of the First Baptist Church in the days of his young manhood. Notwithstanding his large business interests, he still finds time to devote to the duties of his church and Sunday School, of which he was superintendent for many years; to the work of the Young Men's Christian Association and more than one struggling young man in the city has been encouraged to right living by the kind and thoughtful words of this Christian gentleman.

On his twenty-third birthday, Mr. Barney was married to Miss M. Belle Huffman, eldest daughter of the late William P. Huffman, for many years an honored trustee and beloved benefactor of Denison University; and thus the future interest of the young man in that institution of learning seems to have been doubly assured. What lasting impressions were made upon his mind by the conferences of his father with these friends and the elder Thresher to which he was admitted! What loyalty was inspired by their sacrifices in the early history of the college! What a monument is Science Hall of love toward a noble father whose name was already inseparably linked with that history! What

a well-spring of joy within the heart of the giver as he contemplates its broad field of usefulness! What an object lesson of consecrated wealth to every student who enters its portals! The history of Denison could not be written without mention of the elder Barney—and the Scientific Department of the future will date its real beginning and credit its real progress to this generous gift of the son.

Dignified and modest yet cordial in manner, cultured and refined from contact with books and men as well as by extensive travel, a devoted lover of home and family, a keen observer of passing events, conscientious and honorable in his business life, Mr. Barney has been an honor and a blessing to the city and community in which he lives, to the Baptist denomination in general and to Denison University in particular.

ELIAM E. BARNEY

ELIAM E. BARNEY.

*ELIAM E. BARNEY, to whose memory Barney Memorial Science Hall was erected, was born at Henderson, New York, October 14, 1807. His father, an enterprising farmer, had made up by private effort for the deficiencies of his school training and was a man highly esteemed among his neighbors. He served in the War of 1812 and his wife, Nancy Potter of Masachusetts, was the daughter of a soldier of the Revolution. Eliam was the oldest of eleven children. Among the traits recorded of his boyhood, perhaps the most suggestive of his future career were the industry and the orderly method which he displayed in all that he had to do. In his fourteenth year he experienced conversion and became a member of the Baptist Church, a connection which he maintained during a long lifetime, bringing ever increasing wisdom into the councils of the denomination and showing towards worthy denominational enterprises a liberality commensurate with the means at his command.

His preparation for college was secured at Belleville, New York, in the school since known as Union Academy. Rev. Joshua Bradley, who fouunded the Academy, and lived for a time in the Barney household, afterward came to Ohio and acted as a traveling agent for Denison University, then known as Granville College. Eliam entered as a Sophomore at Union College, riding from his home to Schnectady, one hundred and thirty miles, in his father's wagon. To pay the expenses of his college course he had borrowed some money from an uncle and to this was added what he could earn by teaching a writing school and acting as tutor for less advanced students. During a part of his senior year he taught a public school, reciting with his class only at intervals. Thoroughness and accuracy in thought and expression was his ideal.

He was graduated in 1831, and was soon afterward made principal of Lowville Academy, a position which he filled very successfully for the two years following. Among his assistants here was Miss Julia

*Abridged from Memoir by Rev. H. F. Colby, D.D.

Smith, who afterwards became his wife. After teaching at Lowville long enough to pay off the debts incurred for his education, he came to Ohio, whither at his suggestion his father and family had already removed. Visiting Granville in 1833, he was asked to accept for a few months the position of Professor Drury, who had been appointed to a place in the Faculty but had not yet arrived. In this position he was known as a very popular and effective teacher.

As his temporary term of employment at Granville drew to a close, he wrote letters to the Postmasters of several towns in Ohio, inquiring for a possible opening as a teacher The Postmaster at Dayton alone responded. He accordingly went to Dayton and found that a principal was to be chosen for the Dayton Academy. He and another applicant were called before the trustees to make a statement as to what they each considered the best method of conducting such a school, and as a result of this test he was immediately chosen. The terms proposed to him and accepted were that he should take the building rent free, assume all financial risks and receive all profits. A brother and sister were at once taken as assistants, and two other sisters were afterwards added, as the school rapidly grew in numbers. In 1838, he was an active promoter of the first movement to provide for public schools in Dayton. In 1839, the trustees of the Academy insisted that he should begin to pay rent for the use of the building, and not deeming this equitable he resigned and opened a school at his own house. This was afterwards removed to the basement of the Baptist church and continued with success for about two years when signs of failing health caused him to seek employment of a different nature. He then purchased a sawmill and managed it for two years and a half with financial success, but entered so actively into the labor of his business that his health was injured, rather than benefitted, by the change. A trip to the South, followed by another to the East, brought renewed health, and he was then persuaded to enter the educational field again, as principal of Cooper Seminary, founded in 1844. This school opened its doors in September, 1845, and enrolled one hundred and seventy-four young ladies during its first year. The Seminary made a noble record for thorough work, honestly living up to the statement of its advertisement, "Those who dislike to study or are unwilling to comply cheerfully with all school regulations, or who go to school merely because they are sent, will do well to seek some other place in which to idle their time

away. We wish only such to attend as are desirous to make rapid improvement and determined to apply themselves closely to study."

Mr. Barney had taken the Seminary for five years, and at the expiration of this period decided again to go into business. He formed a partnership with Mr. Ebenezer Thresher, and after careful consideration they decided to engage in the manufacture of railroad cars. For the first year, however, Mr. Barney was a silent partner, continuing his work at the head of the Seminary that long at the urgent request of the trustees. Mr. Barney and Mr. Thresher put in $5,000 each at the beginning of their manufacturing partnership, and the business prospered from the start, their cars obtaining a reputation for excellent workmanship and material. In 1854, Mr. Thresher withdrew, because of ill-health, and was succeeded in the firm by Mr. Caleb Parker, of Massachusetts. The firm suffered temporarily from the financial panic of 1857, but was on too solid a footing to receive permanent harm. Mr. Parker retired from the business in 1864, and was succeeded by Mr. Preserved Smith. In 1867 the firm was incorporated under its present name "The Barney and Smith Manufacturing Company, of Dayton, Ohio," and its history has been one of safe and steady progress ever since. A description of the works at the present time would hardly be called for by the nature of this sketch, but perhaps it will not mislead to reprint a description written soon after Mr. Barney's death, remindtng the reader that the business has made during the seventeen years intervening just such progress as might have been expected from the foundation which Mr. Barney had laid:

"The visitor to the works as they are at the present time (1881) cannot fail to be impressed by their extent and the amount of painstakng labor which is there employed. Every kind of car, from the common platform to the most luxurious drawing room or sleeper, is turned out by skillful workmen, and the rapidity with which large contracts can be filled has often occasioned surprise. The blacksmith shop with its many forges; the large machine shop, with its complicated and beautiful appliances for working iron economically; the foundry, that can turn out one hundred and forty wheels a day; the two buildings of fine machinery for cabinet work; the separate shops for putting together the trucks, the freight cars, the passenger cars, or for painting them all filled with work in different stages of progress, and populous with men laboring together with exact system and precision—form a little world of industry and of wonderful interest to a thoughtful mind.

Two large engines furnish the motive power, wire ropes transmitting it to the various buildings. Such are the facilities for drying and working lumber that freight cars have been delivered, ready for use, in a few weeks only after the wood composing them was growing in the forest; but to keep available material for every kind of work, the Company has an extensive yard, with a railroad through the center, wherein is piled lumber for two hundred and fifty passenger cars and one thousand freight cars—the usual stock carried amounting to nine million feet. The factory, with its appurtenances, covers twenty eight acres of ground, and the capital stock now amounts to seven hundred and fifty thousand dollars. At Mr. Barney's death the number of employes was over a thousand."

Such, in 1881, was the industry which Mr. Barney and Mr. Thresher had founded thirty years before with a capital of only ten thousand dollars.

From the same source as the above (A Tribute to the Memory of Eliam E. Barney, by Rev. Henry F. Colby, Pastor of the First Baptist Church, Dayton, Ohio) we quote the following paragraph in description of Mr. Barney's characteristics as a business man: "Of course, he was often indebted to the prudent counsel of the partners with whom it was his privilege to be connected, and to the faithful co-operation of experienced men who were intrusted with the different departments. But for many years he was at the head of the establishment, and to his personal traits its growth and reputation were largely owing. Except when he was traveling for the business—and a large portion of his time was thus occupied, sleeping cars furnishing him his rest as he traversed wide sections of country—he was wont to be at the factory from early morning till the whistle sounded at night. He was conscientious, laborious and watchful in the extreme. He not only superintended subordinates but seemed to keep his eye with wonderful particularity on the innumerable details of the work. His presence and impress were everywhere. In the factory his was the living spirit among the wheels. He had the decision, the power, the control of an imperial commander. Each employe must come promptly up to the terms of his engagement and fulfill it; for the last hour of his day's work was the Company's profit, the other hours were necessary to earn his wages. Any form of ill behavior was reprimanded, no matter on whom the censure might fall. No work must be turned that was not the very best. Employes at first, like some other people, took his strongly marked visage, his

strictness, his positive judgments and peremptory answers, for sternness. Sometimes his replies to those who sought his counsel would be brief, and he would seem to be absorbed in something else. He would even at times disregard those little courtesies which make men seem approachable. But if the matter really was one that required his help, the applicant would find in a day or two that Mr. Barney had thought it all over and had some plan to suggest or some relief to offer. He threw men upon their own resources to develop them, and then reached out his hand to keep them from falling. They who came to know him well found out that no one could have a kinder heart or be more ready to help those in trouble."

Doubtless many who read this bulletin have met in one place and another evidences of the deep interest which Mr. Barney took in advocating the cultivation of the Catalpa tree for timber. He gathered and published statistics as to its rapid growth and durability, and through the columns of the Railway Age and other journals suggested that railroad companies should cultivate the tree along their lines for use as ties. Letters of inquiry concerning the tree came to him by thousands, and as the result of his efforts millions of Catalpa trees are now growing in this and other countries.

His gifts to Denison University at various times aggregated nearly seventy thousand dollars, and he was also instrumental in securing the financial support of others. In addition to this he gave much time and thought to the school as a member of its Board of trustees. Doubtless to his services as a teacher also, in 1833, is due in part the tradition of thorough work in the class room which it has always been the special effort of the University to maintain.

This hurried sketch must necessarily fail to give anyone a complete conception of Mr. Barney's lifework and personal characteristics. It may indicate, however, the type of men to which he belonged,—men of keen insight, unceasing industry, thorough and orderly habits of thought, conscientiously upright in every detail of life, of unobtrusive modesty and yet strong in conviction, and always generous to any good cause or deserving individual in proportion to the means at command.

DEDICATORY EXERCISES.

The dedication of Barney Memorial Science Hall occurred June 13th, 1894. The following account of the exercises is taken from the press notice in the *Granville Times* of June 14th :

"The dedicatory exercises of Barney Memorial Hall occurred on Wednesday morning at a quarter past nine o'clock. As the cases had not yet been placed in the Museum a platform was erected in its east end for the speakers and the main floor and gallery, with all the available space in the adjoining hall, was crowded with visitors eager to participate in celebrating the completion of a building which means so much for the future of Denison in the field of scientific investigation.

"All regretted the absence of Mr. Barney, through whose liberality the building was erected, but the ceremony of turning over the keys to the Board of Trustees was fittingly performed by the Chairman of the Building Committee, Mr. Albert Thresher. Dr Colby, the President of the Board whose remarks at the laying of the corner stone are remembered by many, accepted the keys with a graceful recognition of the faithful manner in which the committee had discharged its trust, and presented them in turn to President Purinton.

"In the remarks made by Dr. Purinton special stress was placed upon the recognition of the great truths of the Christian religion in all the scientific work of the University. Attention was also called to the recognition of the work of the Denison laboratories of leading scientists throughout the civilized world as shown by the exchange of the publications of learned societies in all lands for the bulletins of our laboratories and the Journal of Neurology.

"At the close of the President's remarks an earnest and touching dedicatory prayer was offered by Rev. Mr. Lounsbury, of Dayton, pastor of the church with which Mr. Barney is connected.

"The President then introduced the principal speaker of the occasion, Prof. J. J. Stevenson, of New York.

"The leading feature of the exercises as a whole was the assurance given that Denison is not to make the vital mistake, in entering upon a broader career of scientific investigation of nature's facts and laws, of leaving out of consideration the divine mind of which these facts and laws are but the outward expression."

VIEW OF GRANVILLE FROM BARNEY MEMORIAL SCIENCE HALL

DEDICATORY ADDRESS.

SCIENCE AS AN EDUCATIONAL FACTOR.

When a magnificent building is dedicated to scientific studies, one's thoughts turn naturally to consider the bearing of such studies upon education itself: and so it has come about that Science as an Educational Factor, is the topic upon which and around which I am to speak to-day.

When patristic philosophy established a tribunal to which should be referred all questions whether of physical science or of theology, it closed the door to individual thought and opened the way to the bondage of the dark ages. This new philosophy practically proclaimed that investigation beyond what is revealed in Scripture is science falsely so-called—Augustine himself, when discussing the existence of the antipodes, said that "it is impossible that there should be inhabitants on the opposite side of the earth, for no such race is recorded in Scripture among the descendants of Adam." Necessarily, the study of nature was forbidden in fact, if not in word, physics being regarded as merely tributary to revealed theology. Monks and schoolmen occupied themselves largely in making copies of the "Fathers" or in applying the principles of Aristotelian logic to systematization of all things, physical and metaphysical. The revival of learning, though influenced by the Arabian mode of thought, carried into Europe by the Jews, was but a revival of intellectual activity along lines of study pursued for centuries. Monasteries yielded stores of ancient literature, which they had preserved as an old chest preserves valuable documents; authors, known until then only by name or by garbled extracts, became familiar acquaintances, while to them were added hosts of others, previously unknown, whose works afforded full scope for the scholarly acumen of the time.

The Universities of the middle ages taught only such matters as engrossed the attention of the schoolmen; disputations respecting mere abstractions occupied most of the time and absorbed most of the energy of learned men. True, the love of money and the fear of death led many to search for the philosopher's stone and for the elixir of life,

but such studies lay outside of the legitimate lines and those who pursued them were viewed askance. When the revival of learning came, University courses were lengthened and broadened, it is true, but only along the old lines and within the old areas.

The distrust of physical investigation engendered in the ignorance and dread of the dark ages, when popular religion had become almost fetichism, passed away slowly. As in the later days of the gloom, weird tales were circulated respecting Friar Bacon, so even after the revival of learning, doubt pursued the investigator and those adhering to the patristic philosophy were able to thrust Copernicus and Galileo aside. It is true that in Italy, where Jewish and therefore Arabian influence had been felt very early, important studies were made; Leonardo da Vinci and Frascatoro rediscovered the Pythagorean doctrines enunciated by Ovid; physicists and naturalists made noble discoveries, but in great part their results lay buried and almost unstudied until the close of the last century. Even in the early part of this century, the Copernican system was barely known to the great University of Salamanca and the works of Galileo and Copernicus remained on the Index Expurgatorius until 1828.

Within the memory of some who are present, the terms "scientfic man" and "infidel" were, to the majority of good people, practically synonymous, though Dr. Dick's remarkable statement regarding the undevout astronomer had led many to make an exception in favor of the star-gazers. Even when a scientific man asserted his belief in revelation, not a few doubted. It is the prerogative of ignorance to despise or to distrust that which it cannot understand; but not unfrefrequently a package, dreaded as an infernal machine, has proved to be a gift of inestimable value. So here: the dread of physical science has been disappearing rapidly of recent years, for men have come to feel that creation and revelation, having a common origin, must agree in so far as they follow parallel lines, and that disagreements are apparent, not real, being due to error in the interpretation of one or possibly of both. It is too soon to attempt a full reconciliation of the two, as we know them; more study, more growth must be had before men can be fitted for the task; it is still difficult to distinguish between faith and prejudice; Scripture has been overlaid so deeply with prejudices and traditions, that we hesitate often to accept as truths the discoveries made by naturalists and archæologists; too often, when convinced of

error, we give only a half-hearted, half resentful assent to the truth which we can dispute no longer.

The imperfect recognition of the importance of scientific studies, which has continued almost until now, was due in great part to the half distrust with which all physical investigation was regarded; but another influence was almost equally potent. It was an inheritance from older days. Education, formerly, was for the wealthy, for men who were to be cloistered students or lawyers or physicians, all of them, even the physicians, dealing almost wholly in abstractions. Matters of practical utility were beneath the contempt of scholars; utilitarianism concerned only the vulgar sphere of commerce and manufactures. This conception appears absurd to us now, but not long ago, its defenders dominated our colleges, controlled the professions and moulded public opinion; the community believed that study of material things does not cultivate the intellect, that the only elevating studies are those derived from antiquity, with, as the capping stone, that pure philosophy, to which those who study gross or material things can never attain.

The importance of scientific education has been conceded in America, where recognition of the close relations between abstract and applied science could not be avoided; for the application of principles discovered by closet students has made available the mineral wealth of our vast domain, until the United States has become one of the greatest of manufacturing nations. Some Americans, who know little of what their countrymen have done in pure science, seem to regard most of the discoveries in applied science as practically piracies from European students. But Americans have made contributions second in importance to those of no other country; from the days of Franklin to our own time each generation has born its full share of burden in erecting the scientific edifice. Franklin's discovery of the identity of lightning with frictional electricity opened a new world of investigation, while leading to the protection of man against his most dreaded enemy; Rumford's investigations of heat were not understood in all their bearings for half a century, but were the suggestion for Joule and his contemporaries; Henry's studies in electricity opened the way for Morse and Vail and made the magnetic telegraph a possibility; John W. Draper's investigation of light and his investigation of the spectrum, made thirty years too soon, were the first long strides toward the development of spectrography, which, in the hands of German students,

has told us of new elements and, in the hands of Young, Langley, Pickering and other Americans, has told us of the composition of our own as well as of other suns so far away as to be scarcely visible to the unaided eye; the names of Hare, Gibbs and Remsen tell us of stages in the progress of chemistry; while Newcomb, Hall, Barnard, Newton and their contemporaries have done their full share in the advance of astronomy; in ethnology are the monumental works of Pickering and Hale as well as the splendid contributions published by the United States government during the last score of years; in botany, the publications of Torrey, Gray, Englemann, Watson and a score of others are models of accuracy and beauty; in zoology, Baird, Cope, Binney, Hallowell, Marsh, Osborn, Verrill and their many co-workers have labored on the rich faunas of this great continent and their works are regarded as among the marvels of our time; in psychology, so rapidly passing from the region of mere metaphysics to the rank of an inductive science, American investigators are unexcelled even by the patient Germans; time would fail me to tell of those who have attained world-wide fame in geology since the time when Hall, Rogers and Dana were the youthful pioneers, to this day, when instead of half a score, as in 1837, we count more than two hundred and fifty active geologists. America's surveys, geological, geodetic and coast, have been the most extended in the world and the hundreds of ponderous volumes, issued by state or general government and distributed with lavish hand, have astonished other nations—as well they might.

The record of Americans in applied science is even more remarkable than that in pure science; Holley remade the whole Bessemer process so that steel rails can be made in this country for little more than one sixth of the price prevailing twenty five years ago, and our great buildings can be constructed of steel for far less than of iron; the application of Henry's curious apparatus, as made by Morse and Vail, has been modified by a score of workers until at length, by Edison's improvements, it has become not a luxury but an ordinary means of communication; the engineering feats of Americans on the railways of California, Oregon, Venezuela and Chili are unrivaled; but it is not possible to go on with such a list; our advance along all technical lines causes other nations to regard America not merely with admiration but even with perplexed wonder. On one occasion the *London Times* said:

"In the natural distribution of subjects, the history of enterprise,

discovery and conquest and the growth of republics fell to America and she has dealt nobly with them. In the wider and multifarious provinces of art and science, she runs neck and neck with the mother country and is never left behind."

With all this ever present before the American community, it is not surprising that enormous gifts have been made for the foundation of scientific and technical schools; but it is surprising that the educational value of scientific training is so little appreciated and that, in so many cases, technical courses, those involving direct application of scientific priciples, are regarded as of less pedagogic value than are those which concern merely the operations of man's intellect or the immediate products of that intellect. Let us inquire for a little into the educational value of the observational sciences as well as of the technical science growing out of their applications.

Education of to-day is necessarily different from that of one or two centuries ago; then culture alone was sought, often perfunctorily, usually by the wealthier classes and with a view to one of the learned professions, then only three, law, medicine and theology; education then was for the few; now it is for all; then it was a luxury; now it is a necessary preparation for life's work; it is a training, that a man may be able to make the most of himself in some one of the now many learned professions or in some one of the complicated groups of commercial operations. But it is more than mere training, for it has two important provinces: first, to draw out and to train the mental powers; secondly, to impart knowledge. Too long, a disproportionate stress was laid on the former; there is a tendency now in many quarters to lay too great stress upon the latter. The former is the more important, but it must not be separated from the latter.

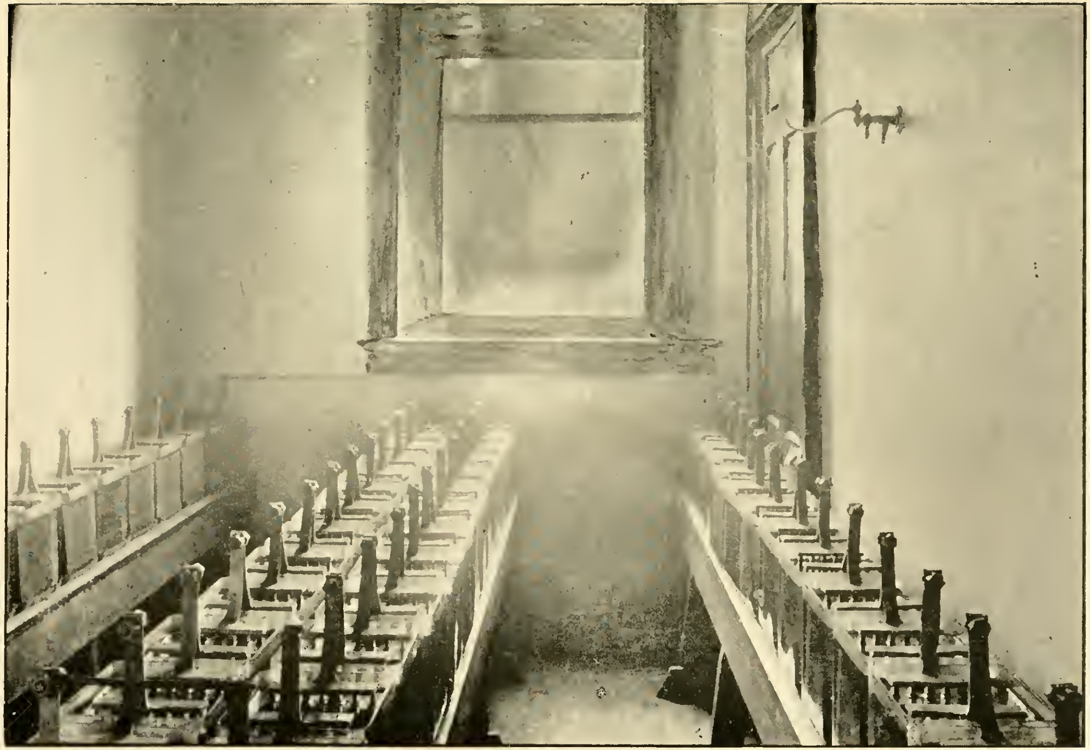
Mental faculties or powers are not independent, even in the sense that a man's limbs are independent portions of his body; the notion of this independence is but a make-shift arising in the class room. Let the mind be regarded as an entity, manifesting itself in many ways, and capable of forming habits or tendencies to act in one direction preferably to another; unguided in its formative period it will come to work along narrow paths, determined by prejudice rather than by reason. Here, as is usually the case, the intellectual powers alone are considered, for ordinary educational work has comparatively little to do directly with culture of morals, though it has much to do with it indirectly; a true culture of the intellect leads to a genuine ethical culture

by inducing a judicial frame of mind, which prefers the right to the wrong.

In the normal child knowledge is acquired first by observation—through the senses; this acquisition leads to the development of that complex series, the power of retaining, that of recalling, and that of recognizing impressions, which altogether make up what is known popularly as memory. But in the process of mere acquiring, the observed things are compared and in that of recognition, things or impressions are recognized largely by their relations; this involves the examination of things apart from other things, of their differences as well as of their relations, the formation of intellectual images and the separation of essentials from non-essentials; whence the wonderful and perplexing queries with which a child assails those who can be reached; all of this leads to the formation of conclusions, of inductions, of general principles; thence to application of principles to matters not so familiar—to the formation of deductions and to the encouragement of a lively imagination.

This briefly is the succession, whether the child be of savage or of civilized parentage. How necessary guidance is during the unfolding we know only too well by observing those who have not had it. Left to itself the mind, seeing things wrongly, makes no effort to see them rightly; fails to apprehend their relations and makes inductions which are absurd and are liable to become dangerous as guiding principles of conduct. We may laugh or in better temper we may smile sadly as we read of Kaffirs who worshipped an anchor as a powerful fetich, because the man who had knocked a chip from one of the flukes, died suddenly; or we may be amused by the folly of a savage, who recognizes a demon in a gentle breeze, which, blowing on his neck, gives him a cold; but these can give a reason for their belief and conduct equally good with that which most of us can give for many beliefs influencing our action.

Education is to guide in this process of development, but creation is not within its province; cannot give intellect or common sense; but if rightly conducted it may strengthen feeble powers as gymnastic exercises may make the left hand almost equal to the right; it can take the ill-developed entity with irregular surface, not to cut away or diminish any power but to strenghten those that are feeble. As a gardner, desirous of gaining more shoots from the plant, spreads the crown that light may come within and cherish the dwarfed buds, so educational



STORAGE BATTERY ROOM

training endeavors to make the mind stronger, broader, more symmetrical, and, at last, finer, that the character may have at first strength, then beauty. Success in the effort is not always certain, for the mental treasure is in earthen vessels, very frail, too often of poor material, very porous and without much glaze; but we have the ideal —how may we attain at least partial success, the most possible?

Two schools answer this question; but they have little in common beyond the belief that there is a human mind which is in sore need of cultivation.

The old school finds the best means in the study of abstractions; it holds that the study of languages, especially of the classical tongues, affords the best basal training; it would place a child in earliest youth at this study to sharpen the intellect by dwelling on niceties of expression and on the recognition of delicate distinctions, so producing exactness of thought and precision of statement while strengthening the verbal memory; with this study, though subordinate, is to be associated that of mathematics, with excursions in other directions; but emphasis is laid on the classical work because of its humanizing effect; the lad is preparing to read ancient authors in the original, to become acquainted with the philosophy and to partake of the refinement found only in writers of antiquity when the influence of the shop and the love of money were not reflected throughout literature.

The other school in bitterness of spirit speaks scoffingly of these claims and denies that the classical languages are taught in our schools and colleges; its advocates challenge the defenders of the older system to produce the graduates of the ordinary college courses who can read ancient philosophers in the original; they assert that, of college graduates who have spent from eight to ten years in the study of Greek and Latin, only a small percentage can take a work previously unread and read it with any degree of ease; they assert that two thirds of the college graduates are unable to read their diplomas; they refer unpleasantly to the statement that in theological seminaries, text-books in scholastic Latin were abandoned not so much because the theology was antiquated as because the students were found to be studying Latin instead of learning the theology: they prove that while the great works of antiquity, unless in the Bohn library, are sealed books to the ordinary classical student, the works of French, German and Spanish authors are not sealed books even to those who have spent very much less time in the study of those languages—and this too in spite of the com-

plexity of German and French idioms They assert that Greek and Latin are taught as mere abstractions, that instead of Greek and Latin, there is taught a universal grammar, for which German or English could be used, for which Goethe or Shakespeare would answer as well as Sophocles or Horace. They assert too that this method of training is unjust to the man; that thereby it is possible for men to enter the Christian ministry or to be admitted to the bar, even though ignorant of the simplest processes of nature and of the most commonplace facts in agriculture and the mechanical arts; that men who pass through college courses and enter upon business pursuits, show unfitness for concrete things and lose valuable time in learning to utilize their mental training. They maintain that a study of God's works of creation is a vastly better occupation for the present and for the future than is the study of the human intellect, which, by some accounts, has fallen sadly from its first estate and by others has risen none too far above it.

As in very many other cases, the truth lies between these extremes, but it lies nearer to the modern school than to the other—a truth which has gained recognition rapidly during the last score of years, as appears from alterations in the college curriculum. The times have changed and our methods must change with them. Two centuries ago Latin was the common language of learned men and its place in the curriculum was as important as French and German should be now—and for the same reason. But that reason no longer avails for the retention of Latin in its exceedingly prominent place. Greek is necessary still for the the theologian just as is Hebrew, which is begun usually in the seminary, though a wise regard for the needs of theological students has led some colleges to place it among the electives. The great value of Greek and Latin as now taught lies in the polish imparted; the teaching does little toward expanding the intellect, it tends rather to make the mind great in little things; its place is not at the beginning but at the close of training. The intellect must first be shaped, then polished; the great effort prior to the college course must be to develop: true training will endeavor to assist, not to thwart nature.

In the earliest training, the studies of greatest prominence should be such as to aid the natural order of development; elementary botany, mineralogy and zoology have materials everywhere, alongside of every path. Observing under the care of a teacher, who knows not merely what, but also how to observe, leads to the habit of comparison; the relationship of groups becomes apparent and how to make inductions

respecting cause and effect is learned—the most important of all preparatory stages; after these the study of one's self comes naturally, first of the tangible self and then of the intangible thinking self; for elementary psychology is as attractive to a youth as is elementary physiology, and no more difficult. In this manner, while the process of gathering knowledge goes on, there advances with it the process of enlargement and strengthening, while the process of refining is not neglected in these and associated studies—it is only subordinated. But a time comes when more than mere guidance, more than a gentle effort to prevent irregular development is needed, when native tendencies show themselves too strongly and restraint or positive direction is necessary; the process of culture, thus far merely incidental, must become prominent And here is the place of the college.

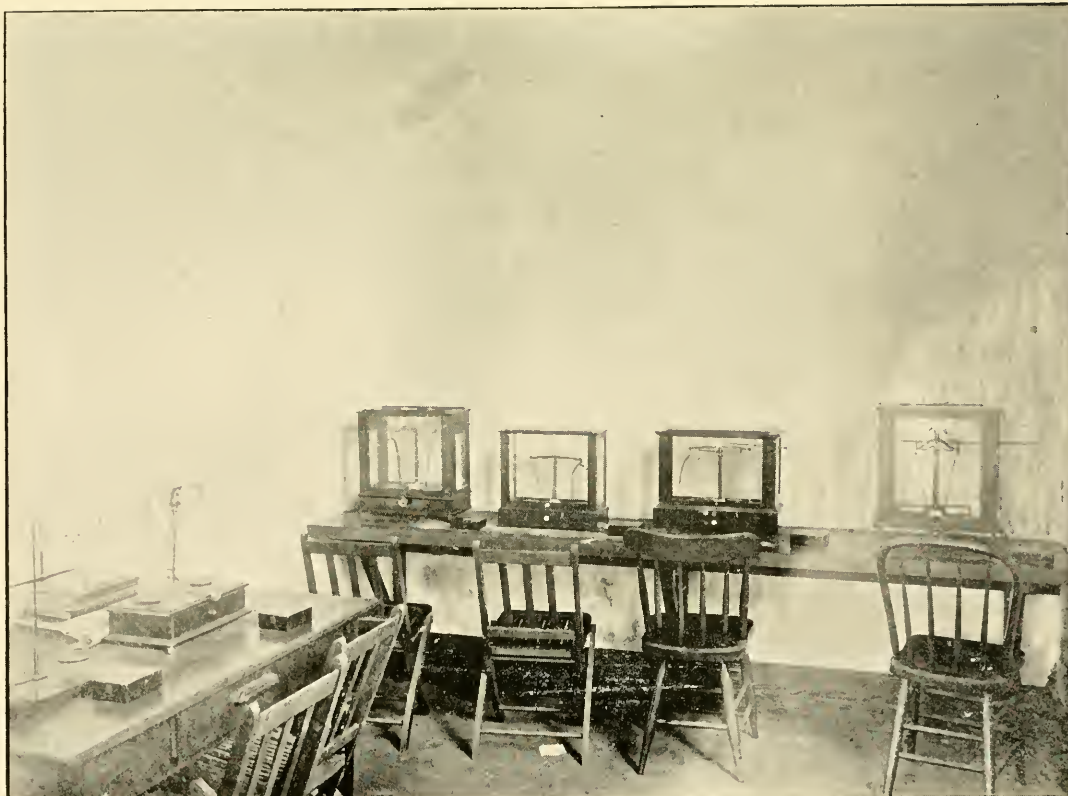
The main object of college work is not to train men for their life work but to prepare them for receiving such training—a fact too often forgotten now, when colleges are endeavoring to engraft university conditions upon the college curriculum. The question is not what will be best suited to the man's intended pursuit, but what will make him best able to receive and profit by the immediate preparation for that pursuit.

Yet, while recognizing this as the main object, we must not neglect another consideration. Life at best is very short, and the portion spent in college, from 17 to 21, is that during which, upon the whole, the mind is most receptive, retaining, as it does, a great part of the absorbing power characterizing childhood, while it has gained not a little of the ability to acquire by reasoning. It is wrong to permit this portion of life to pass without giving opportunity to acquire knowledge. We live in a time when men are expected to leap into active service at twenty-five; when opportunities for readily increasing one's stock of general knowledge disappear quickly after life's work has fairly begun. No wonder that we hear so often the cry of *cui bono?* respecting the older and even respecting some of the newer modes of training Not a few of those who believe that language and mathematics can be taught and should be taught so as to cultivate the very faculties reached especially by natural science studies, are inquiring earnestly, Why should so much of life be spent in the mere process of getting ready to get ready? Surely something of real service beyond mere training should be acquired during the process. The curriculum should be prepared with this matter in view, as far as is possible, without inter-

fering with the main object of college work. We are told often that a man who spends an hour in sharpening his ax is likely to do more and better work during the day than the man who refuses to spend the morning hour in sharpening; but the man must have his breakfast as a prerequisite. In the case of the human mind, the implement and its user cannot be separated, they are one - and this is where the simile fails, despite its frequent use as an end of all argument. The man who spends all his time only in sharpening is less likely to do the full tale of work than is the one who ate a good breakfast and neglected the sharpening. But given the sharp ax and the better breakfast, there can be no doubt as to the quality of the work. Strong man and sharp ax together answer to the human mind, strong, cultured and well furnished.

Thoughtful men feel that there is a serious defect somewhere in our methods; keen, bright students find many of their studies irksome, and a few of them attractive, despite the fact that oftentimes those teaching the attractive studies are less skillful than the others. Long ago, the wise man told us that much study is weariness to the flesh; but certainly it is no more a weariness than are baseball, football, cricket, boating, foot-races or squirrel hunting; physical exercise of these types is taken with a zest which all understand. And all understand equally well that exercise thus taken is vastly more beneficial than the irksome exercise of the daily "constitutional" taken under the direction of a physician. There is no reason why mental exercise, to be beneficial, should be irksome, should have the task feature prominent. The difficulty in the curriculum lies in the undue proportion of certain types of study.

The preponderance of studies looking to culture is far too great—studies without apparent relation to present or future conditions as far as the student can see, even toward the end of his course. No matter how willing a man may be to work, he cannot work heartily if there be no apparent result; the most hopeful of men needs a little occasional fruition to keep him up; pounding a log with the blunt end of an ax is not half so cheerful work as chopping. The curriculum should commend itself, in *some* degree at least, to the intelligence of the student as of practical value, for interest is a vastly better incentive than discipline. More stress should be laid on such studies as geology, physics, chemistry and biology, including here psychology, of which now only the merest elements are taught in the arts courses of many leading col-



BALANCE ROOM

leges; such studies should not be subordinated to the so-called culture studies for they are culture studies themselves of a very high type; the study of universal grammar leads to precision, that of these studies even more; the former requires delicate perception of resemblances and differences, the latter even more; the former strengthens verbal memory, so does the latter while strengthening and cultivating the sense memory also; but the study of the latter does far more, if properly conducted; it leads the man to become careful of his positions, to be cautious in making inductions, to be less tenacious of his opinions and to be tolerant of the opinions of others, that is, to maintain a judicial frame of mind. At the same time, scientific studies should not predominate greatly in the curriculum lest irregular development result. At graduation the man ought to have laid a foundation for whatever pursuit he is to follow; he should have the polish and ease coming from the study of language and literature, the logical mode of thought coming from the study of mathematics, with the knowledge, strength and judicial tendency coming from the study of inductive sciences.

Yet this is not all that should result from college training. No mere collegiate course, though it embrace the best features of all, can lead sufficiently to such breadth of view as will enable the student to make special application of his knowledge or of his methods to every day problems. Such training is left ordinarily for post collegiate years, but it would be vastly better if some were received during collegiate years. It can be imparted by means of the so-called technical courses, say, for example, mining or civil engineering. Those courses require a very thorough knowledge of the general studies; no parrot like preparation in mathematics, mechanics, geology or chemistry will avail; the principles must be understood so as to be used readily and to be applied in all their bearings and relatioas with accuracy and despatch; for problems are presented to students which involve consideration of events apparently remote, of conditions apparently unrelated, and the reconciliation of forces apparently the most antagonistic. The whole process is that followed in later life, when a man must determine his procedure in business or in professional work by careful consideration of present conditions in the light of experience. This is recognized in France, where only a small proportion of those taking technical courses do so with the intention of making them the basis for a professional career.

By such combinations of studies can be given the training which will fit the average man for the duties of life and which cannot fail to render the feeble man much less incompetent to make his struggle for existence.

At the dedication of this beautiful building, we cannot fail to foresee some of the advantages which must accrue from the muificence of its founder. Scientific men and the public throughout this region will be brought more closely together, a familiarity, unlikely to breed contempt on either side, but likely to lead each to learn from the other to cultivate a due humility. It will aid in gaining a hearing for scientific men and in assigning the so-called "practical man" to his own place ; it will remove prejudices and will protect the community from great loss of money and of comfort; the place of the several departments of science will be understood and the good people of Ohio will not expect a botanist to determine the worth of a coal estate, a geologist to discover the habits of insect plagues or to discover means for their extermination, a physiologist to discuss the best localities in which to bore for natural gas, or a naval officer to make the preliminary reconnaissance for a railway route. Before long, there will be no danger that the Legislature will be asked to investigate the honesty of a noble and devoted State Geologist because he warns the state against the sinful waste of a great blessing, such as natural gas. In a word, the influence of this School of Science will hasten the fall of the charlatan who fattens on the ignorance and cupidity of the community.

And now, may I say a word to the students and to the alumni of Denison University? The ultimate, absolute success of this institution will depend largely upon you. The tie between alumnus and Alma Mater, which some affect to ridicule, is genuine and material Be the fees what they may, they never suffice to defray the cost of instruction; in American colleges, the cost per student is from three to even twenty times the fee, the latter proportion being that in state institutions, where fees are very small. The indebtedness therefore is not ideal but real. Let the alumni hold this school very near to their hearts; let them make its museum, let them build up its library ; and as their prosperity increases, let them help it in other ways, that it may become stronger and stouter, able to do better work in each decade than it did in that preceding. New friends may be raised by an energetic president, but unless the alumni form a constant stream of thoughtful care takers, the burden of chasing for new friends becomes ere long a thankless task. But if you cherish and support you Alma Mater, there will be no difficulty in crying *Esto perpetua* with a sturdy faith that the prayer will be answered.

DENISON UNIVERSITY CAMPUS FROM THE SOUTH

BARNEY MEMORIAL SCIENCE HALL.

Barney Memorial Hall is located in a beautiful situation, south of the library building and the Academy dormitories, on the elevated slope above the buildings of Shepardson College. It is built of the best Zanesville buff pressed brick, with the lower story and trimmings of buff Amherst stone. It consists of a main central portion 50x70 feet, four stories high, with two wings, each 46x36 feet and three stories high The construction is very massive, with two thick interior walls running lengthwise through the main portion and two others separating the main building from the wings. The building is thus divided vertically by heavy brick walls into five distinct parts. The foundation rests for the most part on the bed rock below. This solidity of construction is important in securing the necessary freedom from vibration for the use of delicate instruments.

The building is heated by steam, partly by direct radiation and partly by indirect. A high pressure boiler is used, with an automatic reducing valve which keeps the pressure on the building at any desired point. Good ventilation is secured in the following way: in the first place by introducing fresh air at six different points to steam coils from which it passes to the rooms above ; in the second place by a system of foul-air registers which communicate with two brick stacks about 75 feet high, surrounding the high cast iron chimneys connected with the boiler. The heat of the inner iron chimneys produces a strong draft in the outer stacks which rapidly removes vitiated air from the rooms.

The building was designed by Peters & Burns, of Dayton, in the colonial style of architecture, to suit the special requirements of laboratory use. It contains forty rooms, most of them adapted to some distinct purpose. They are plentifully provided with blackboards, sliding chart frames, dust tight cases, gas, water, steam, slate-topped tables and fume cupboards for carrying corrosive or disagreeable gases from the working rooms. The plumbing is very complete, water being distributed to about sixty points in the building and gas to many more than than that. All sinks are provided with traps that can be readily

opened and the plumbing of the toilet rooms has been carried out in the most approved manner.

The general electrical equipment of the building occupies a large room in the basement and consists of a 55 horse-power boiler, a 50 H. P. Ball engine, direct-connected to a 40 K. W. Thresher multipolar dynamo, which gives a current of 350 amperes at 115 volts This plant is in operation every evening, supplying light to a number of dormitory buildings and at the same time, with the aid of a 10 H P. "booster" dynamo, charging a large storage battery which consists of 60 cells of chloride accumulator of 600 lamp-hour capacity. This battery supplies current for light during the remainder of the night, and the next day for general laboratory uses, including current, lights, power for the shop motors, and heat for special purposes.

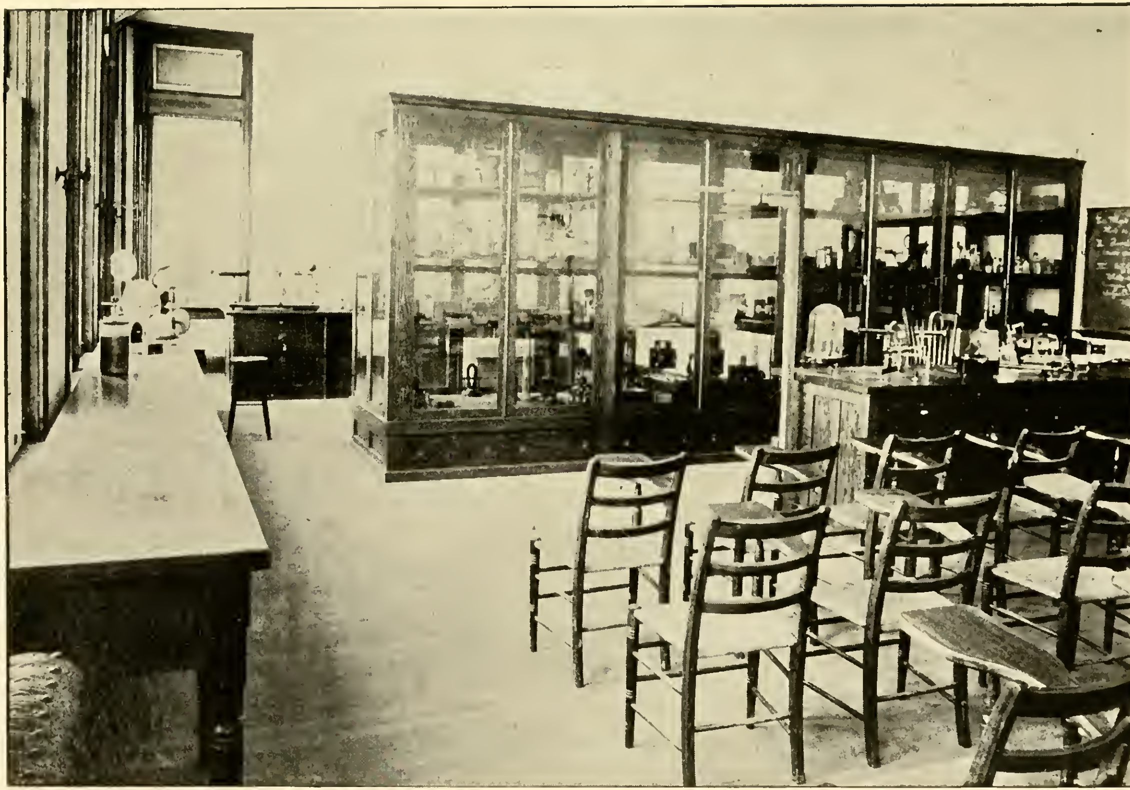
The gas used in the building is gasolene gas and is supplied to all the rooms by a Detroit gas machine of 75-light capacity. It is used principally for heating, in Bunsen burners, gas stoves and assay furnaces for testing ores; but it also supplies light to some rooms not yet wired for electricity.

Three electric lanterns and two complete outfits for producing the lime light, give good opportunity for illustrating all subjects by stereopticon projections. The numerous applianes peculiar to the several laboratories will be described in connection with the special accounts of those laboratories.

Besides the first cost of about $40,000 for construction, over $15,000 has been spent for equipment.

DEPARTMENTS OF PHYSICS AND CHEMISTRY.

THE DEPARTMENT OF PHYSICS occupies ten rooms, most of which are on the south side of the main building. Its equipment has cost about $7,000. The lectures in general physics are given in a large room (45x26 feet) on the first floor. This is a laboratory and lecture room combined (marked "General Physics" on the plan). A large apparatus case, 20x5x8 feet, enclosed by glass doors so as to be accessible from either side, almost bisects the room near the center. The east end of the room is used for lectures and recitations, the other end for individual laboratory work. In this way apparatus is placed so as to be convenient for either purpose. The lecture portion contains seats for 35 students, a long demonstration desk, furnished with a tank-sink, gas and wires from both the dynamo room and laboratory room. An electric lan-



GENERAL PHYSICAL LABORATORY

tern always stands ready for projections, and a porte-lumiere in a south window enables one to throw sunlight wherever it may be desired. A beam stretches across the room above for heavy suspensions. The other end of the room is provided with laboratory desks. One along the south side of the room is 35 feet long. A wider table runs nearly across the room at right angles to the first Beside this there is a large stone slab supported upon a heavy brick pier, which passes through an opening in the floor to the solid rock 17 feet below. This gives a support for delicate instruments that is free from floor-vibrations. From one corner of this large room a photometry room, 12x5, is cut off. This can be made perfectly dark, for measuring the intensity of various sources of light and other optical work. Another small room, 14x8 feet, is connected by an arched space to the large room and can be readily cut off for special work. It contains a stone table set in a corner made by two 24-inch walls for steadiness, a sink and a large fume-cupboard with a tile conduit to the draught-stack, also one or two moveable tables.

On the second floor are a number of rooms for more advanced work. One (marked "Advanced Physics") 26x17 feet, is furnished with a sink, about 15 gas terminals, electric wires from the dynamo room, a table across one end supported by heavy brackets from the outer brick wall, and a number of very solid moveable tables. A suspension beam runs above through the length of the room. This room contains much of the finer apparantus, as the dividing engine, standard meter, various certified standards of electrical resistance, potential, and capacity, standard thermometer, heliostat, reflecting galvonometers, mercury pumps, induction coils, X-ray outfit, saccharimeter, precision balance, etc. A research room opening from it is equipped with water, gas, electricity, stone shelf set in brick walls and a special low-voltage circuit from the battery room. The room marked "Study" (13x11 feet) contains also a small department library for advanced students. Opposite this is the photographic dark-room of this department. It contains two sinks, gas, electricity and light-tight closet.

In the basement beside the engine and dynamo rooms, there are three rooms, completing the physical equipment. One is a large shop, 22x21 feet, for apparatus construction. It is provided with a 3 H. P. electric motor which takes current from the dynamo-room for running the line of shafting, which distributes power to two lathes (one screw-cutting), a circular saw, emery wheel and polishing head. This shop is well stocked with hand tools for both wood and metal work, and a

forge stands in an adjoining room. The next room is provided for certain kinds of electrical testing connected with the study of dynamo-electric machines. It is not yet fully equipped. Near the other end of the basement is a small room about 9x7 feet, surrounded by heavy stone walls and projecting back into the earth. This construction makes its temperature very constant and it is to be used as an even temperature vault for carrying on work which needs to be done at a constant temperature.

The Department of Chemistry occupies the west wing of the building. It contains eight rooms, none of them directly connected with rooms of any other department, so that the odors peculiar to a chemical laboratory do not give trouble elsewhere. The lecture room and beginners' laboratory is a combination room on the first floor. It is 36x33 feet in size, provided at one end with a long demonstration desk, fume-hood, apparatus cases, sliding chart frame and blackboards, in the centre are seats with writing arms for about forty students, and on the remaining three sides 24 working desks, each with water, gas and chemicals, also two more hoods and reagent cases. Electric wires bring current at low potential (six volts) for electrolytic work, from the battery room below. The analytical chemistry occupies a room on the second floor, 36x18 feet. It has a demonstration desk, working desks equipped with water, gas and reagents for 24 students, fume hoods, drying ovens, steam coils, apparatus for distilled water, etc. Adjoining this is the organic laboratory, 20x14 feet, equipped with desks, sinks, hood, etc., especially arranged for organic synthesis. It is used also by advanced classes in water analysis, gas analysis, electro chemistry, etc. A fine set of Hempel apparatus for gas analysis has been added recently, also Beckman's apparatus for determining molecular weights by the lowering of the boiling point of solutions. Both these rooms have permanent connections for 6-volt current from the battery-room and an auxiliary storage battery is kept in this room. Beyond is the balance room, 15x19, containing four analytical balances and several for other purposes. A chemical stockroom, 15x5 feet, opening into both the analytical and organic rooms, is well furnished with chemicals. It can be shut up perfectly dark, and is therefore used by qualitative students for work with the chemical spectroscope. For general supply there is a larger stockroom, 21x10 feet, in the basement. Adjoining this is a fire-proof acid vault, 12x8 feet, for storing large quantities of acids,

GENERAL CHEMICAL LABORATORY

corrosive or highly inflammable substances. The assay-room, 14x14 feet, is also in the basement. It contains a long desk on one side, shelving for chemicals, a coke muffle-furnace, gas muffle and crucible furnaces, a good supply of tools, scorifiers, cupels, etc. An electric furnace for highly refractory substances, has just been placed in this laboratory.

DEPARTMENT OF GEOLOGY AND BOTANY.

The Department of Geology occupies three large laboratories exclusive of the museum.

The general laboratory of geology (18x24 feet) is in the southeast corner of the east wing on the basement floor. It is equipped with case for illustrative material, chart and map cases, charts, maps, globes, models, drawing tables with elevating tops and other necessary apparatus. The laboratory of mineralogy (18x26 feet) is also in the basement and on the south side of the main building. It is furnished with slate topped work tables, with tin lined drawers and reagent racks in middle of the tables, gas, blowpipes, blast lamps, fume hoods, micro scopes and a good collection of working minerals. This laboratory is also used for the microscopic work in lithology; lithological microscopes and a good library of slides of igneous and sedimentary rocks are at the disposal of students. The lithological lathes and saws are in the special shop of the geological and biological departments in an adjacent room.

The Department of Botany occupies two rooms on the north side of the main portion of the building on the first floor. The laboratory of phenogamic botany (27x27 feet) is planned to accommodate 24 students. The portion of the room next to the large north windows is furnished with convenient microscope desks which give a cupboard and two drawers to each student, who is also provided with a compound microscope of modern pattern with full set of objectives and eye pieces. The back portion of the room is seated with chairs and serves as a lecture room. A herbarium case occupies the wall space on the south side. A fume cupboard with slate table top fills the corner next to the ventilating stack and connects with it. A water sink occupies the opposite corner. A large black board runs the entire length of the west wall and above this is a sliding chart rack similar to all the other racks in the building. There is also a large chart case provided with a goodly

number of excellent botanical charts. The room is amply provided with water, gas and electricity. The laboratory of cryptogamic botany (19x17 feet) is adjoining. The microscope desks are arranged next to the walls under the windows and are of the same plan as those in the larger room.

The laboratory is fully equipped with the best compound microscopes, microtomes, sterilizers, incubators and a large library of microscopic slides. A large herbarium case contains the cryptogamic herbarium.

The biological photographic dark room and the stock room both open off from the cryptogamic laboratory. A full set a photographic apparatus and a well equipped dark room provided with two sinks, washing tanks, etc., and nicely illuminated with electricity and gas, with sliding colored glass windows giving various colored illumination, affords good opportunity for experimental photographic and microphotographic work.

This dark room is used also by the engraving department for their photographic work.

DEPARTMENT OF ZOOLOGY.

The General Zoological Laboratory (26x27 feet) is a well lighted room on the second floor with north and east exposure. The work tables are arranged along the two outer walls, the remainder of the floor space being used as lecture room. The room accommodates 21 students and each desk is supplied with individual lockers, compound microscope and the conveniences for dissection. Charts, models and mounted skeletons, human and comparative, are supplied, and the wall cases contain those specimens which are most useful in demonstrating zoological types. Much of this material is, however, stored away, pending the time when suitable cases can be supplied for its reception in the museum. A small reference library is also provided.

The Advanced Zoological Laboratory (17x26 feet) adjoins the General Laboratory and is lighted from the north and west. The work tables are bracketed to the outer brick walls to insure the steadiness necessary for high-power microscopic work. The central floor-space is occupied by a large slate-topped table fitted up with the baths and reagents necessary for the embedding the sectioning of tissues for the microscope. Good microscopes of modern pattern, immersion lenses, and several of the most approved types of microtomes, together

ZOOLOGICAL LABORATORY.

with a full list of preserving and staining reagents are supplied. An incubator, sink and slide cabinet complete the furnishing The latter contains a large collection of microscopical preparations illustrating the tissues of the various groups of vertebrate and invertebrate animals and is especially complete in the vertebrate nervous organs.

THE LABORATORY OF PHYSIOLOGICAL AND COMPARATIVE PSYCHOLOGY (26x27 feet) is a large room on the third floor. It contains a Ludwig kymograph, chronoscope, pendulum myograph, time markers, with proper electrical connections, and numerous other pieces of apparatus, many of which were constructed in the machine shop of the department. The equipment is, however, as yet very incomplete. The courses thus far given have been out-growths of the neurological laboratory and in the furnishing of this laboratory attention is directed rather to the requirements of the physiological and comparative aspects of the science than to those of experimental psychology in the wider sense. The library is abundantly supplied with the current neurological and psychological literature and through the medium of the Journal of Comparative Neurology the department is kept in touch with the most advanced movements in these departments.

THE INJECTORIUM (9x12 feet). This is a small room is the basement with cement floor and walls designed as a preparation room for the department of Zoology. In it all rough dissection, injection of specimens etc., is done and alcoholic specimens are prepared and dissecting material stored. It is supplied with the gravity injecting apparatus designed by Professor Tight, sink, work table, tanks and cases.

THE SPECIAL SHOP of the departments of Zoology and Geology occupies a room (17x26 feet) in the main portion of the building on the south side, on the basement floor. It is supplied with an electric motor of 2 horse power which drives the main shaft, which latter is supported by hangers resting on the floor. Besides a good assortment of wood and metal working tools, benches, etc , the power machines include a Royle combination saw, a large screw cutting metal lathe, a wood lathe, a Royle former, a lithological lathe of the Royle pattern and a Royle router. This shop is used by the departments of zoology and geology for the construction of apparatus and by the engraving department for the routing and blocking of plates.

GENERAL ROOMS.

The Museum room occupies the entire East wing on the first and second floors. The second floor consists of a broad gallery around the entire room, thus giving the central space on the first floor two stories high to the ceiling.

The intention is to devote the first floor largely to geology and paleontology and the second floor gallery to zoology. The collections are not at present in place owing to the lack of funds to supply the necessary cases. A large amount of material is on hand but is for the most part stored away to protect against loss and injury until the cases and furnishings for the museum can be secured.

A Recitation and Lecture Room (17x26 feet) furnished with desk and writing arm chairs, black boards, chart racks, etc., is utilized by the various departments.

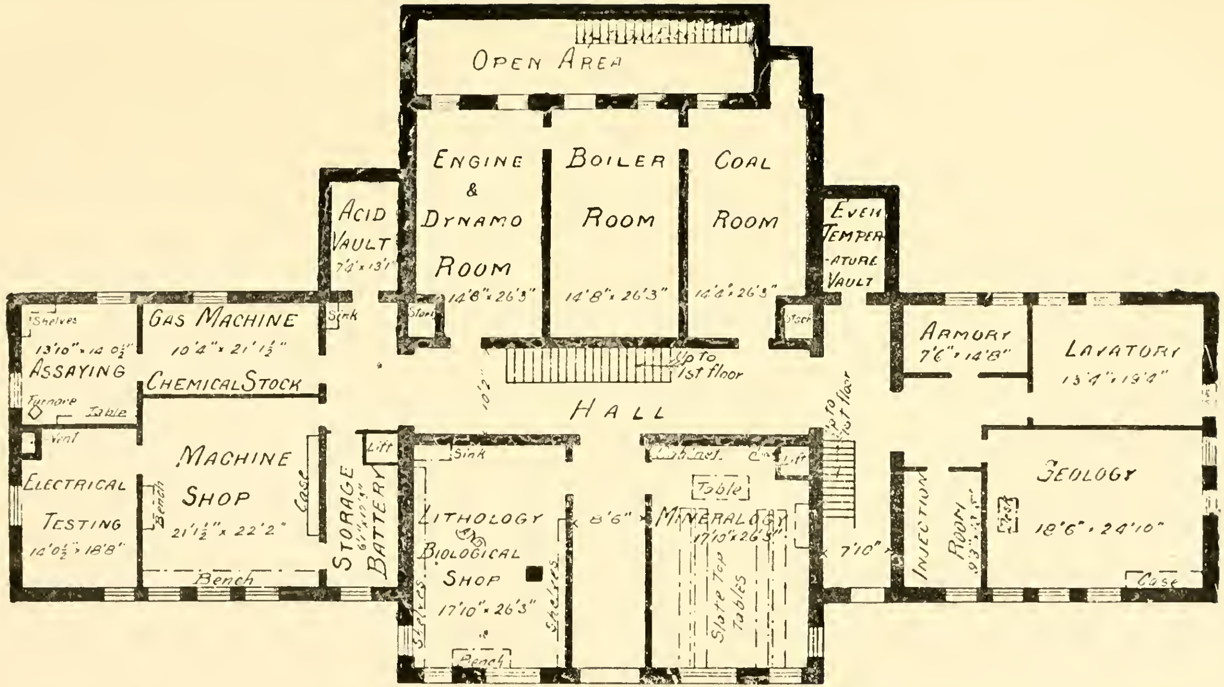
The Denison Scientific Association Room (26x46 feet) occupies the entire south side of the main building on the third floor. The Association holds its bi-weekly meetings here. The room is well seated and supplied with black boards, projection screen, demonstrating desks and sink, electricity and gas, thus making it a very convenient place for the presentation of papers needing illustration or demonstration. At one corner of the room the lift shaft communicates with each floor. The room is also utilized for lecture work by the different departments.

The Scientific Library Room (18x26 feet) is on the third floor and contains the exchange library of the Bulletin and Journal of Neurology, consisting almost entirely of technical scientific literature.

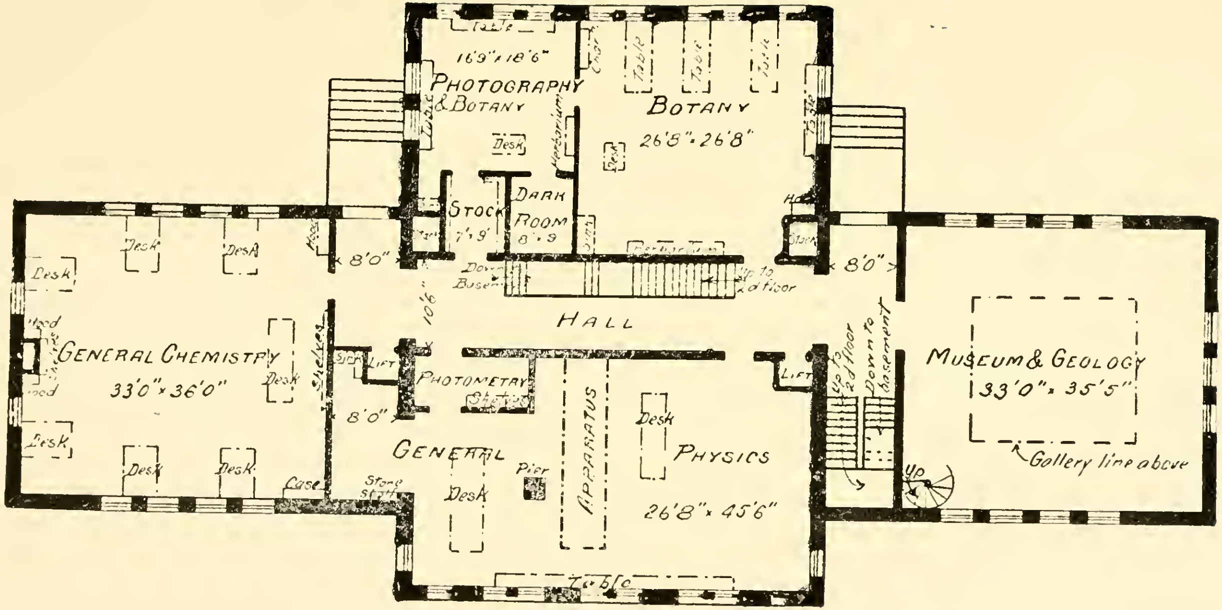
The Attics are two in number (46x36 feet each) and are easily accessible from the third floor main hall, as they are over the two wings. They furnish very convenient storage rooms.

The Lavatories are on the second floor and in the basement and are well furnished.

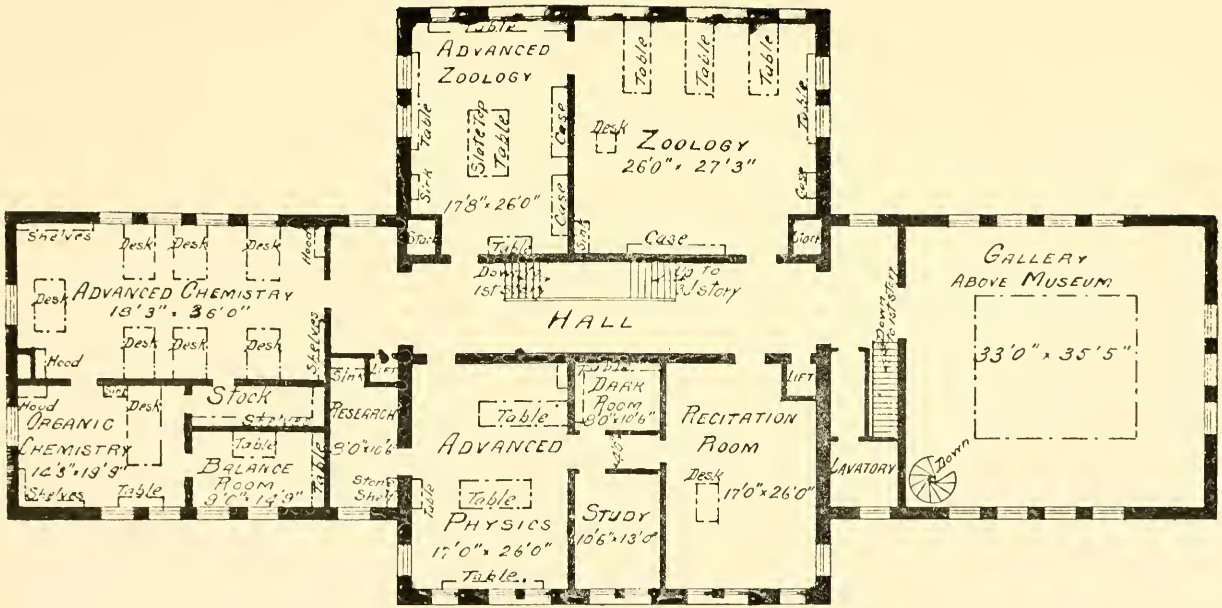
The Boiler and Fuel Rooms are in the north side of the main building next the area way. They are entirely enclosed from the rest of the building by thick brick walls and tile ceilings except through the door leading through the engine and dynamo room, thus furnishing good protection against fire. Chemical fire extinguishers are also placed in the halls on every floor.



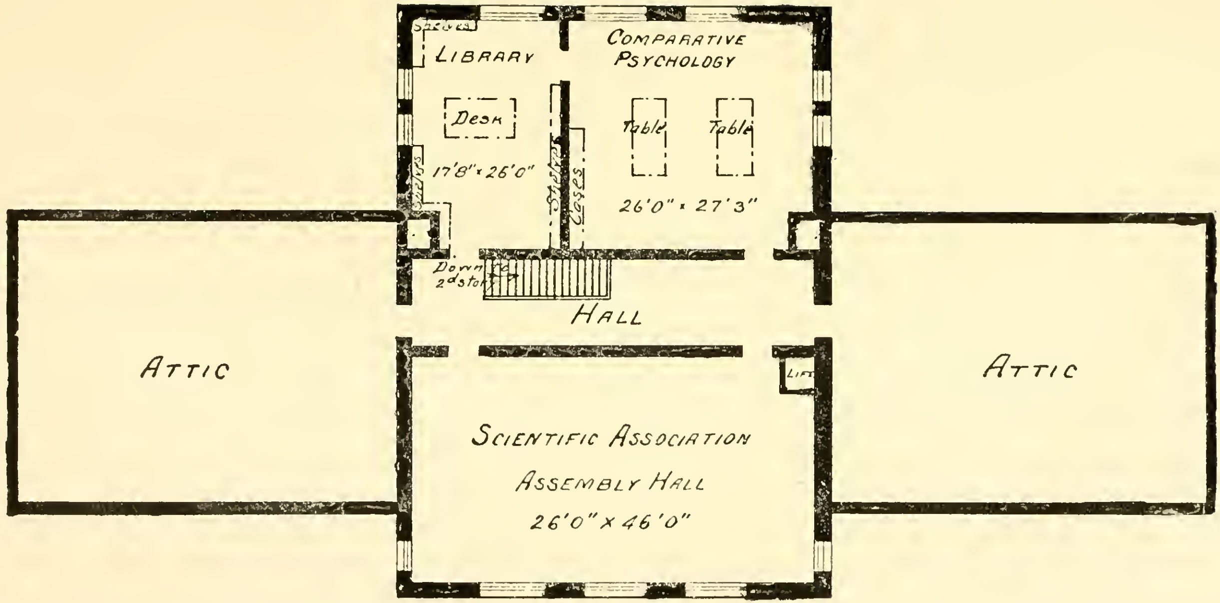
Basement Plan, Barney Memorial Science Hall.



First Floor Plan, Barney Memorial Science Hall.



Second Floor Plan, Barney Memorial Science Hall.



Third Floor Plan, Barney Memorial Science Hall.